Higgs to WW:
Additional Lepton Properties in $H^0 \to W^+W^-$

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Outline

- Review of MC level Acceptance and Acceptance from HepG
- Additional plots of leading particle p_t, $\not{E}_T$ for $M_H = 160$.
- Plots for $M_H = 160$.
- Observations and next steps

	N	Br_1	Br_2	$Br_1 \times Br_2$	$\frac{Br_1 \times Br_2}{Tot}$	Sum
$\mu\mu$	1	1	1	1.00000	0.1111	0.1111
e μ	2	1	1	2.00000	0.2222	0.3333
e e	1	1	1	1.00000	0.1111	0.4444
$\tau_\mu\ \mu$	2	0.17	1	0.34800	0.0387	0.4831
$\tau_e\ \mu$	2	0.17	1	0.34800	0.0387	0.5218
τ_μe	2	0.17	1	0.34800	0.0387	0.5604
τ_e e	2	0.17	1	0.34800	0.0387	0.5991
$\tau_\mu\tau_\mu$	1	0.17	0.17	0.03028	0.0034	0.6025
$\tau_e\tau_\mu$	2	0.17	0.17	0.06055	0.0067	0.6092
$\tau_e\tau_e$	1	0.17	0.17	0.03028	0.0034	0.6126

Trigger Options: Generator Level Study, $M_H =$ 160 GeV/c^2

Lepton 1	20	0	10	10	0	0	20
Lepton 2	10	10	10	10	0	0	10
neutrinos	0	20	20	0	30	20	20
$\mu\mu$	0.99	0.94	0.93	0.99	0.86	0.94	0.93
e μ	0.98	0.94	0.92	0.98	0.86	0.94	0.92
e e	0.98	0.94	0.92	0.98	0.86	0.94	0.91
τ_μ μ	0.63	0.90	0.57	0.64	0.80	0.90	0.56
τ_e μ	0.61	0.91	0.57	0.63	0.80	0.91	0.56
τ_μe	0.63	0.90	0.57	0.64	0.79	0.90	0.56
τ_e e	0.60	0.90	0.56	0.62	0.79	0.91	0.55
$\tau_\mu\tau_\mu$	0.30	0.78	0.38	0.43	0.78	0.91	0.31
$\tau_e\tau_\mu$	0.30	0.77	0.37	0.42	0.79	0.89	0.30
$\tau_e\tau_e$	0.31	0.75	0.34	0.39	0.77	0.88	0.28

Acceptance

Files: $M_H = 160$ GeV/c^2: ww02ca3b.0001x0sk,
$M_H = 120$ GeV/c^2: ww030081.0001x0sg

	M_H =160 GeV/c^2		M_H =120 GeV/c^2	
	HepG 20/10	Good Dilepton	HepG 20/10	Good Dilepton
$\mu\mu$	0.91	0.32	0.65	0.21
e μ	0.91	0.31	0.67	0.20
e e	0.91	0.26	0.65	0.18
τ_μ μ	0.48	0.18	0.19	0.06
τ_e μ	0.47	0.14	0.21	0.07
τ_μe	0.49	0.17	0.18	0.05
τ_e e	0.48	0.14	0.22	0.06
$\tau_\mu\tau_\mu$	0.16	0.04	0.07	0.02
$\tau_e\tau_\mu$	0.11	0.04	0.07	0.01
$\tau_e\tau_e$	0.24	0.08	0.02	0.06

Comments on Acceptance

- The "Good Dilepton" acceptance is events with good dileptons. No attempt has been made to identify the dileptons from the Higgs with those in Hepg.
- Events with reconstructed dileptons is 15% for $M_H = 160$ and 10% for $M_H = 120$
- Events passing 20/10 cuts at HEPG level are 48% for $M_H = 160$ and 33% for $M_H = 120$.
- The PYTHIA MC acceptance for 20/10 are not what is seen in HEPG: need to understand this
- BR ($H^0 \rightarrow W^+W^-$) it 90% for $M_H = 160$ and 15% for $M_H = 120$.

Comments on Acceptance (Continued)

- Consider only the ee,eμ and $\mu\mu$ events:

	$M_H = 160$ GeV/c^2		$M_H = 120$ GeV/c^2	
	HepG 20/10	Good Dilep	HepG 20/10	Good Dilep
	91%	30%	66%	20%

- Consider only the non-τ_h events:

	$M_H = 160$ GeV/c^2		$M_H = 120$ GeV/c^2	
	HepG 20/10	Good Dilep	HepG 20/10	Good Dilep
	78%	26%	53%	16%

- Still a factor of 3 worse than just a 20/10 cut!

Additional Slides requested: $M_{Higgs} = 160$ GeV/c^2

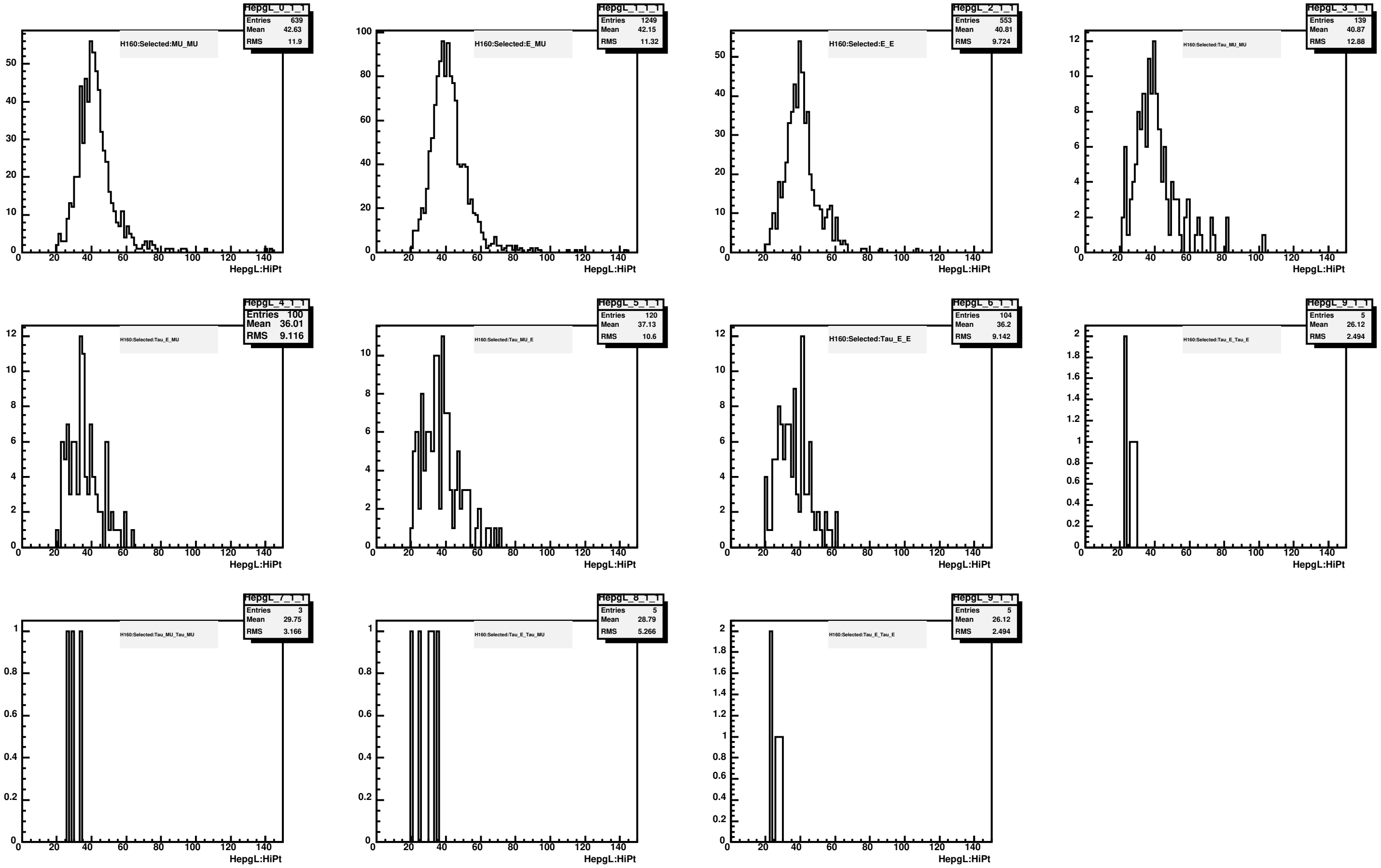
- leading lepton pt (gen. level)
- subleading lepton pt (gen. level)
- dphi between the two leptons (gen. level)
- raw missing Et (rec. level, without any muon correction)
- leading lepton pt vs missing Et (gen. lepton and rec. met)

All plots separated by

- Pass or fail ID of 2 leptons (cosmic filter)
- Type of Hepg dilepton: e,μ or τ decay to e,μ

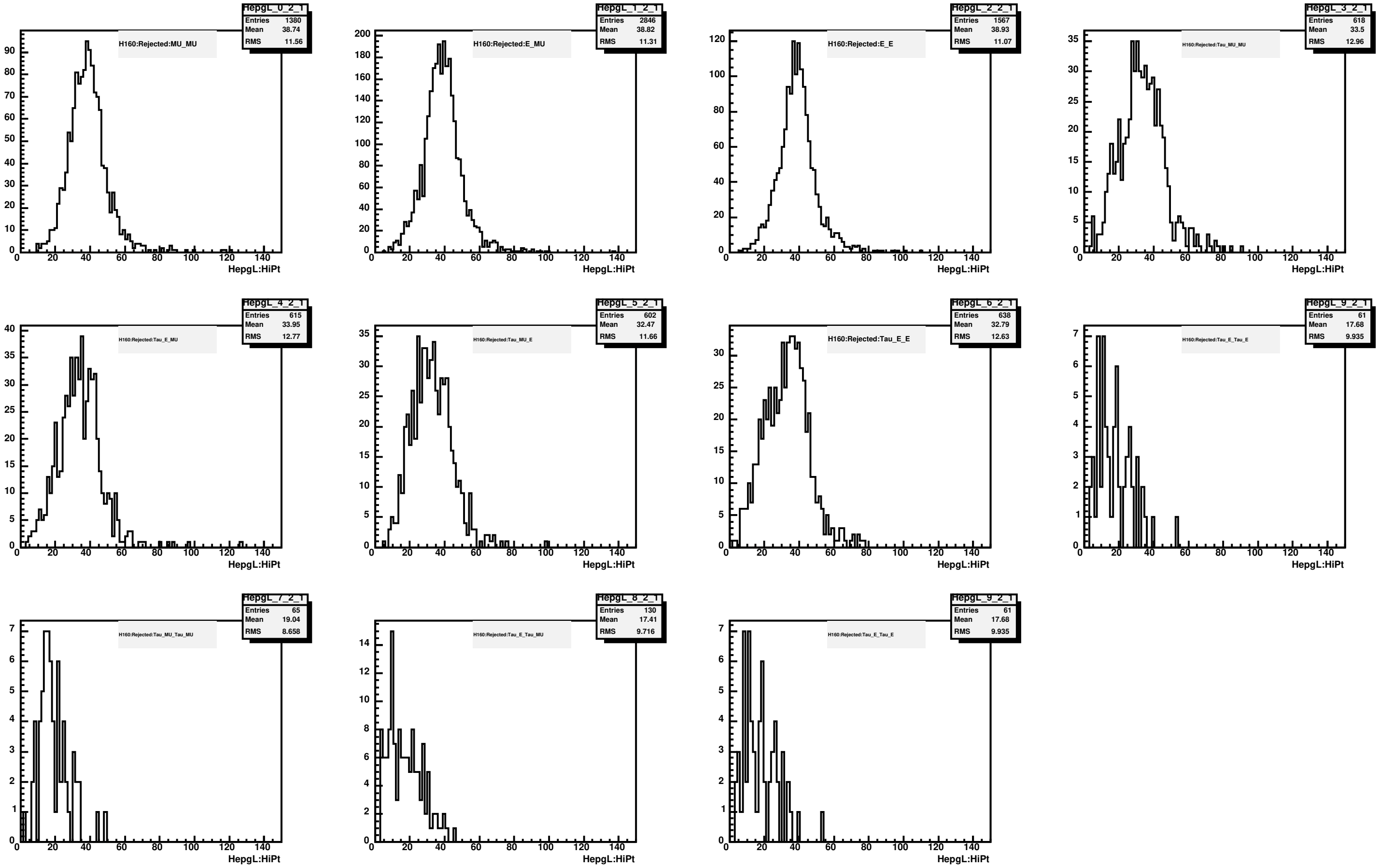
Kinematics: HepG: Leading Lepton Pt

Selected $M_{Higgs} = 160$



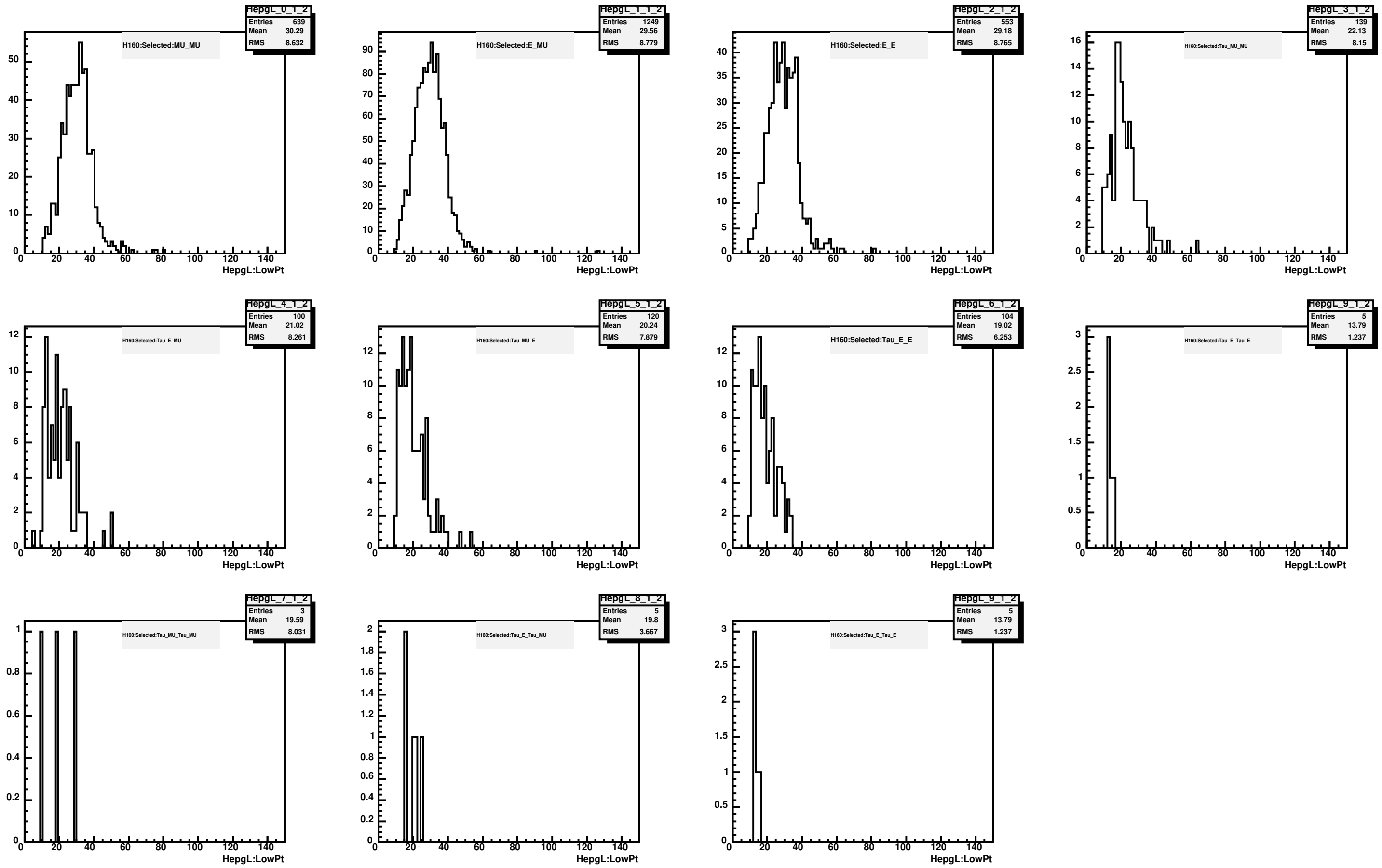
Kinematics: HepG: Leading Lepton Pt

Rejected $M_{Higgs} = 160$



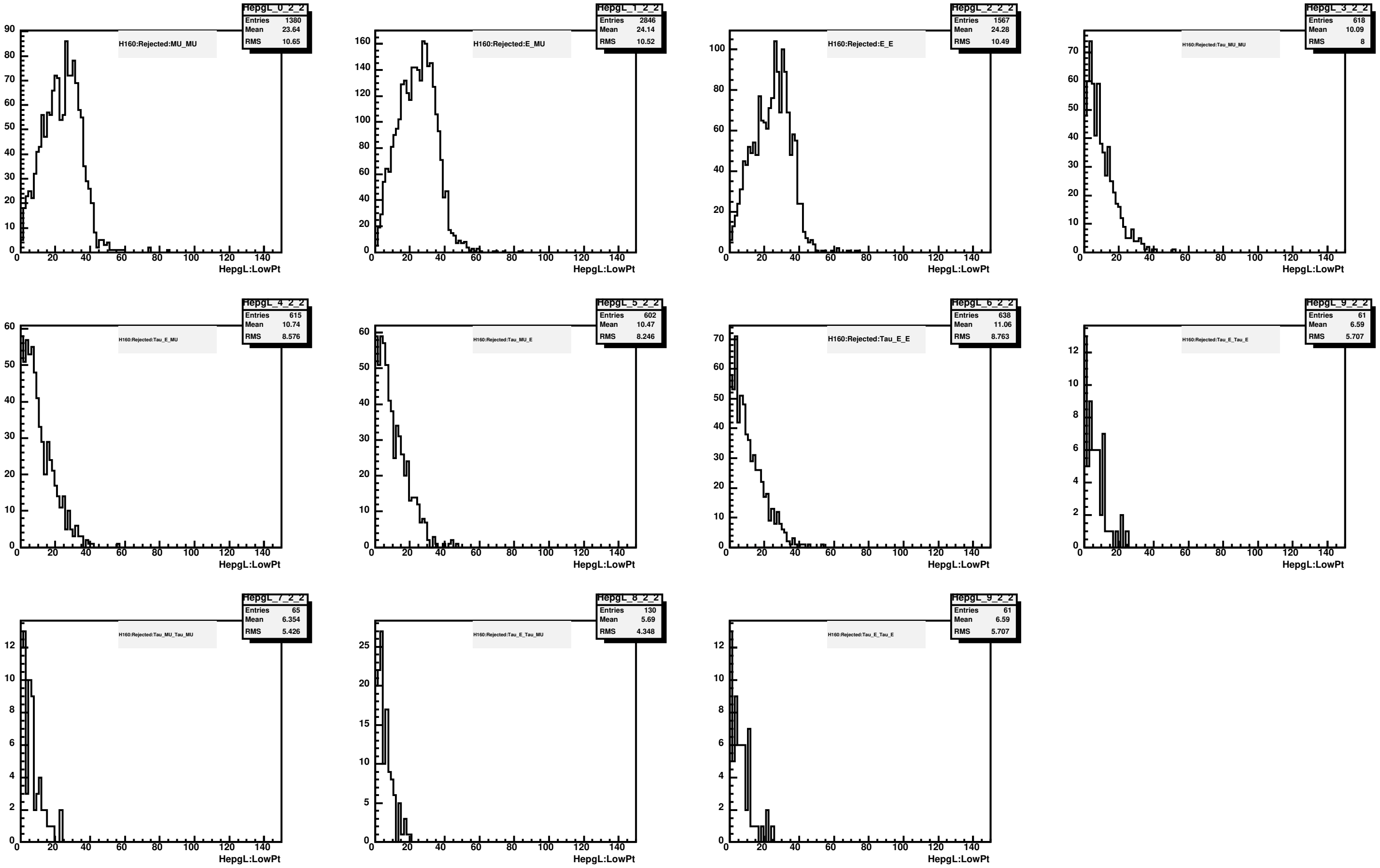
Kinematics: HepG: Subleading Lepton Pt

Selected $M_{Higgs} = 160$



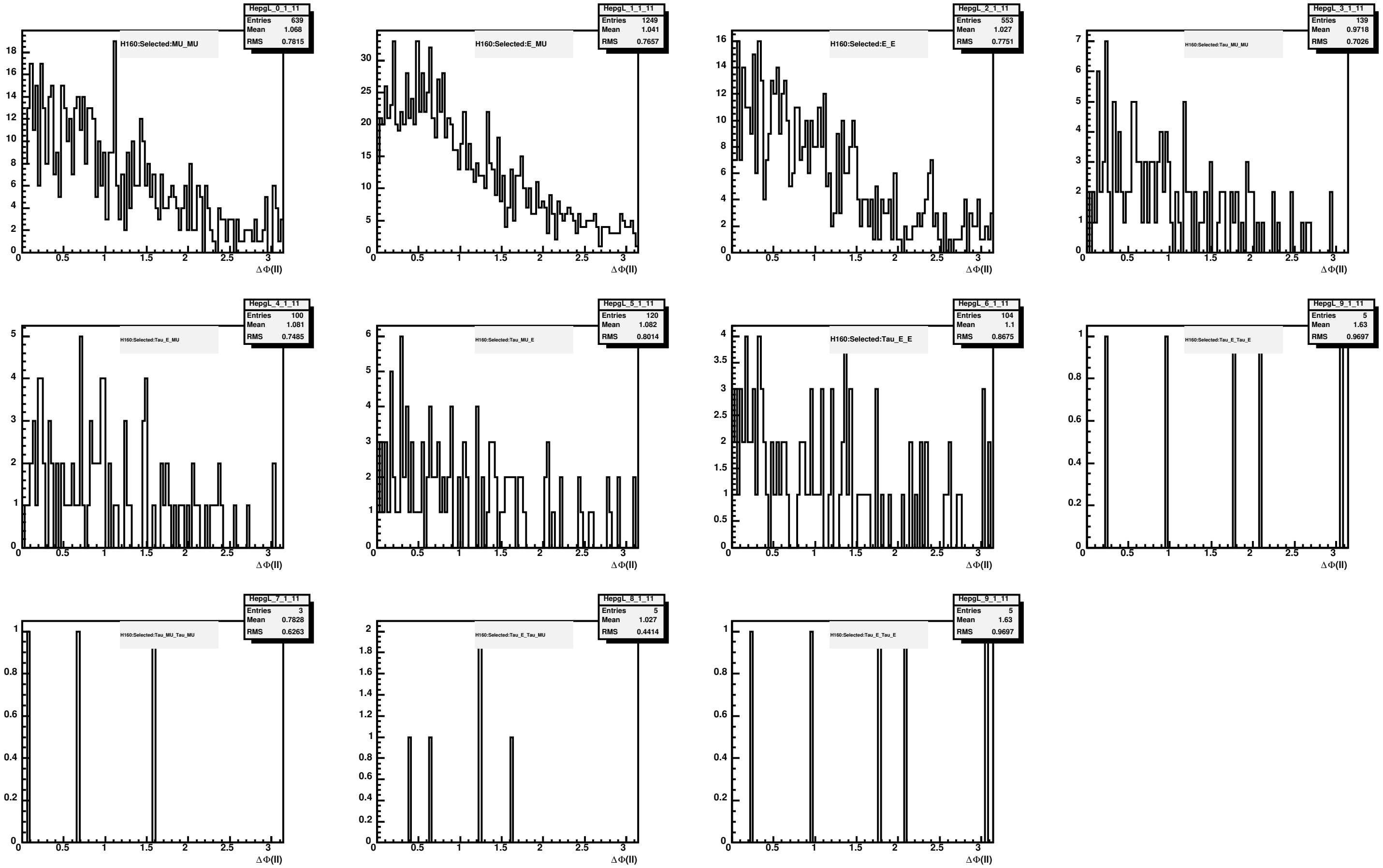
Kinematics: HepG: Subleading Lepton Pt

Rejected $M_{Higgs} = 160$



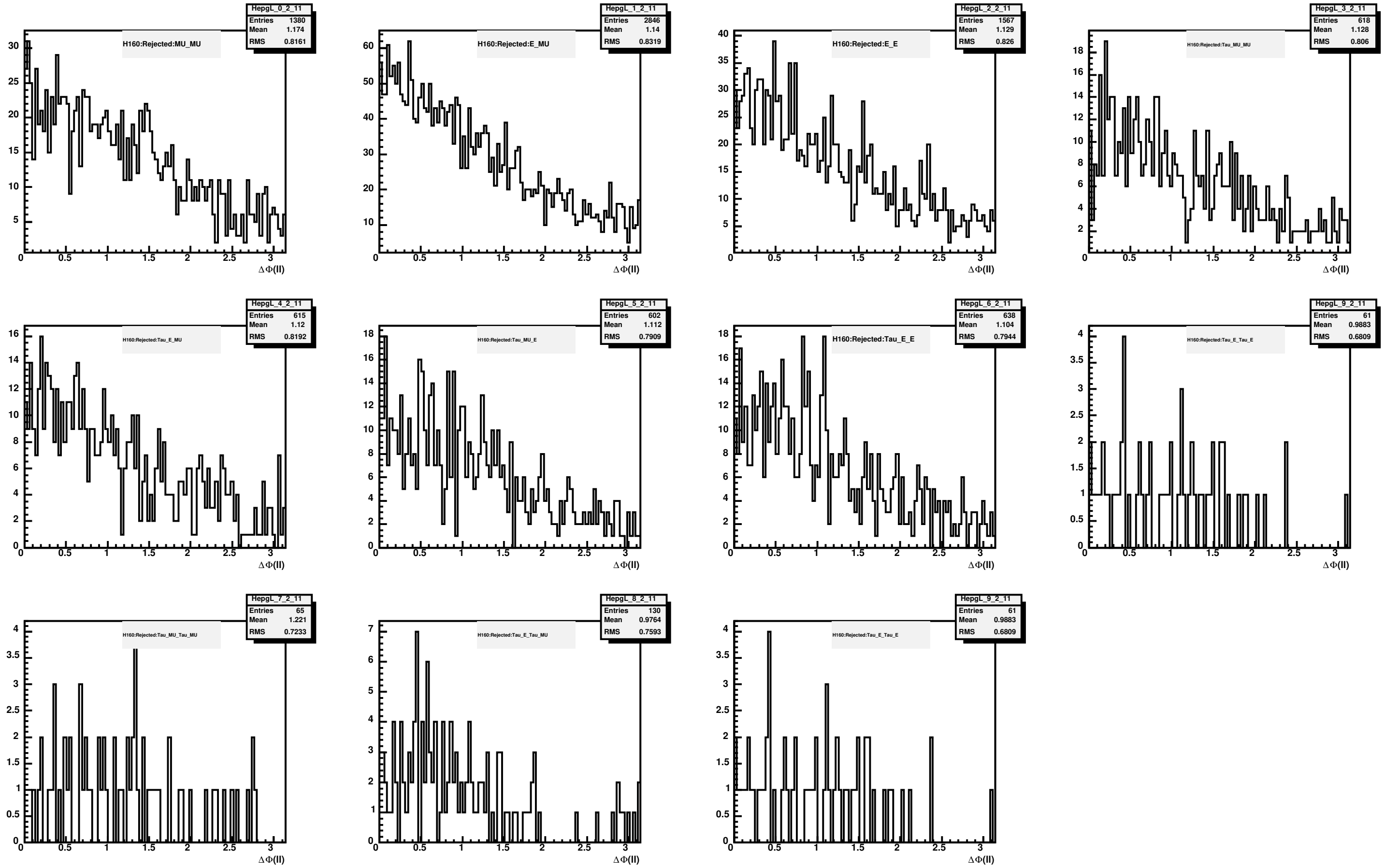
Kinematics: HepG: $\Delta\phi_{ll}$ Selected

$$M_{Higgs} = 160$$



Kinematics: HepG: $\Delta\phi_{ll}$ Rejected

$$M_{Higgs} = 160$$



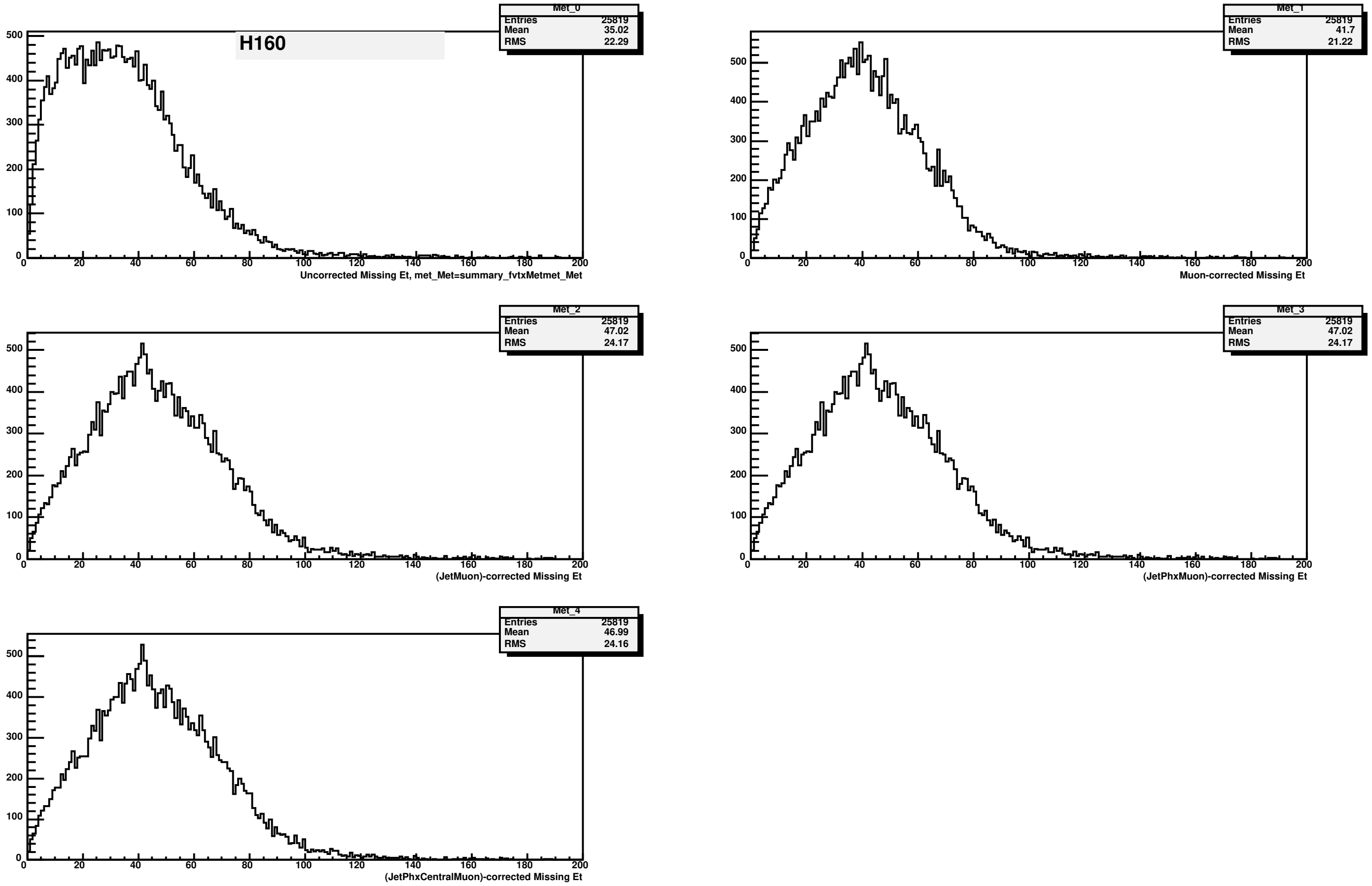
Met Corrections

- For all corrections: $\mathrm{Met}_i - = kp_i$; i=x,y
- Leptons: Cal Isolation of 0.1; PEM 1-9%; TCE .4% (MC)
- Jets: $p_t >> 15$ GeV/c, $\Delta R_{\mathrm{min}}^{\mathrm{lep-jet}} > .4$, $|\eta| < 2.5$

Levels (applied sequentially):

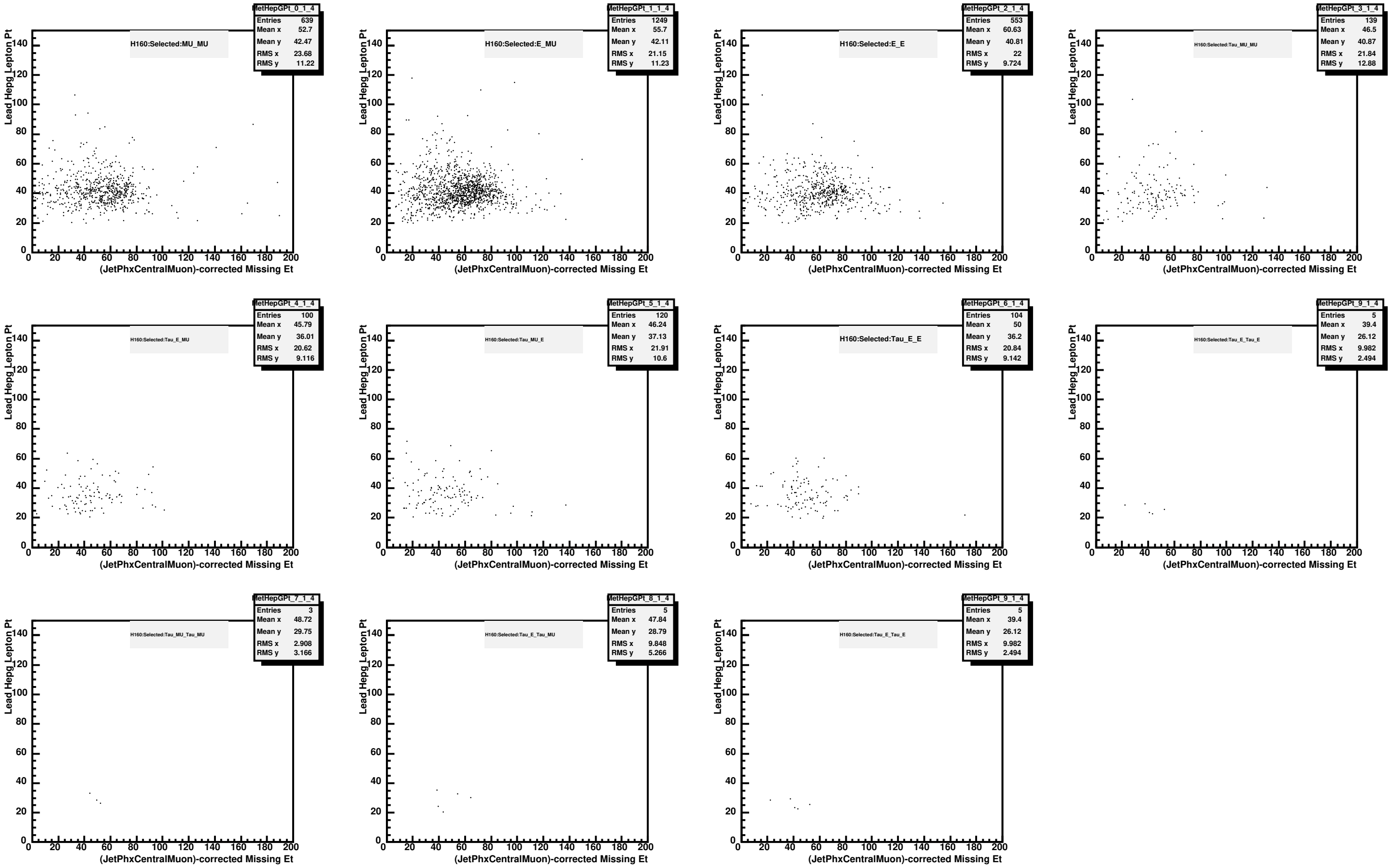
Level	Code	Correction (k)	Plots
Uncorrected	Uncor		VSumPt
Muon	MU	(1- (EM+HAD)/P)	VSumPt
Jet	JM	(1-1/jetcor)	
Phoenix	JMP	(1-1/Phxcor)	
Central El	JMPC	(1-1/TCEcor	Lead Pt,VSumPt

Uncor MET: Reconstructed: $M_{Higgs} = 160$



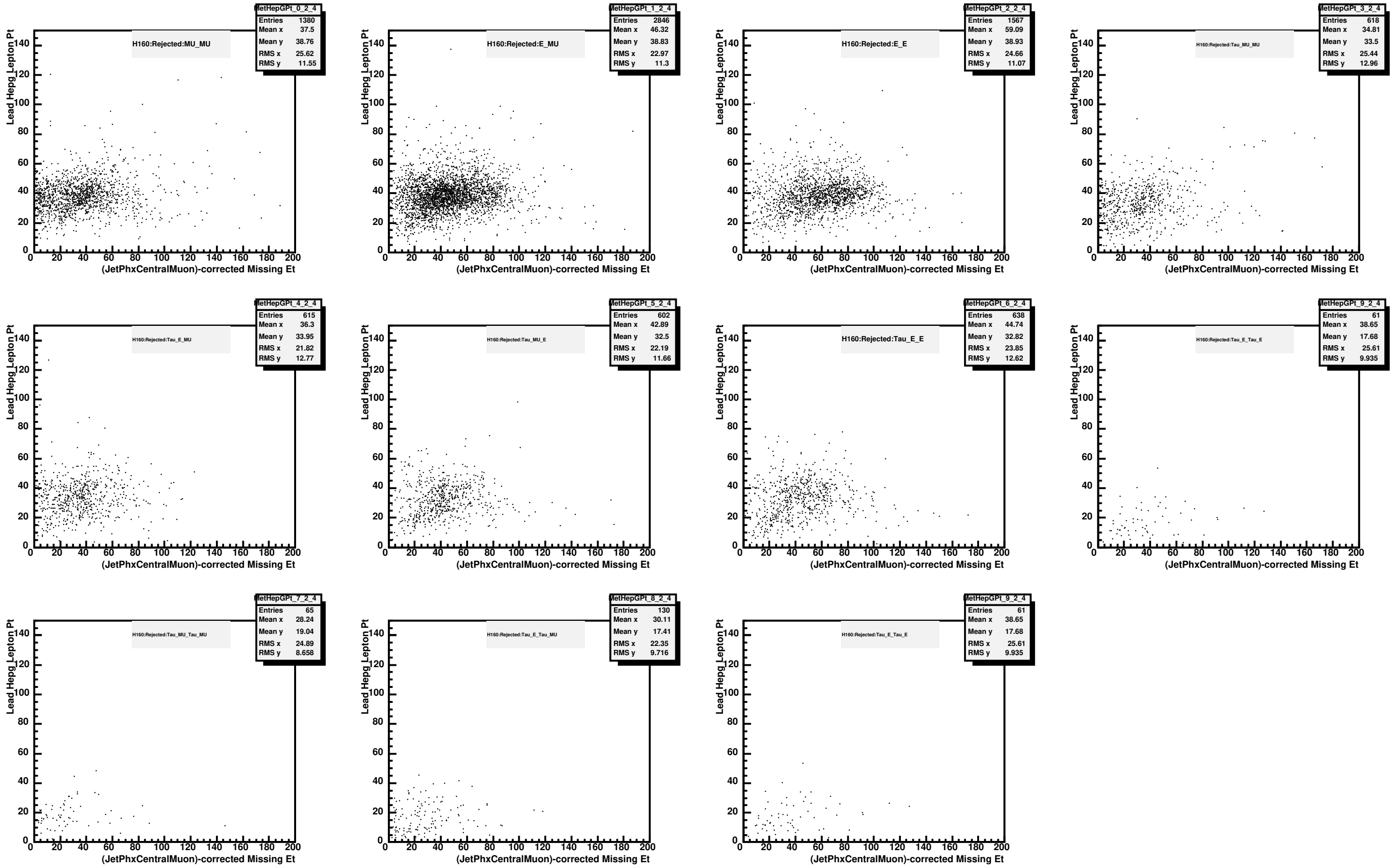
Hepg Lead Pt vs JMPC MET

Selected$M_{Higgs} = 160$



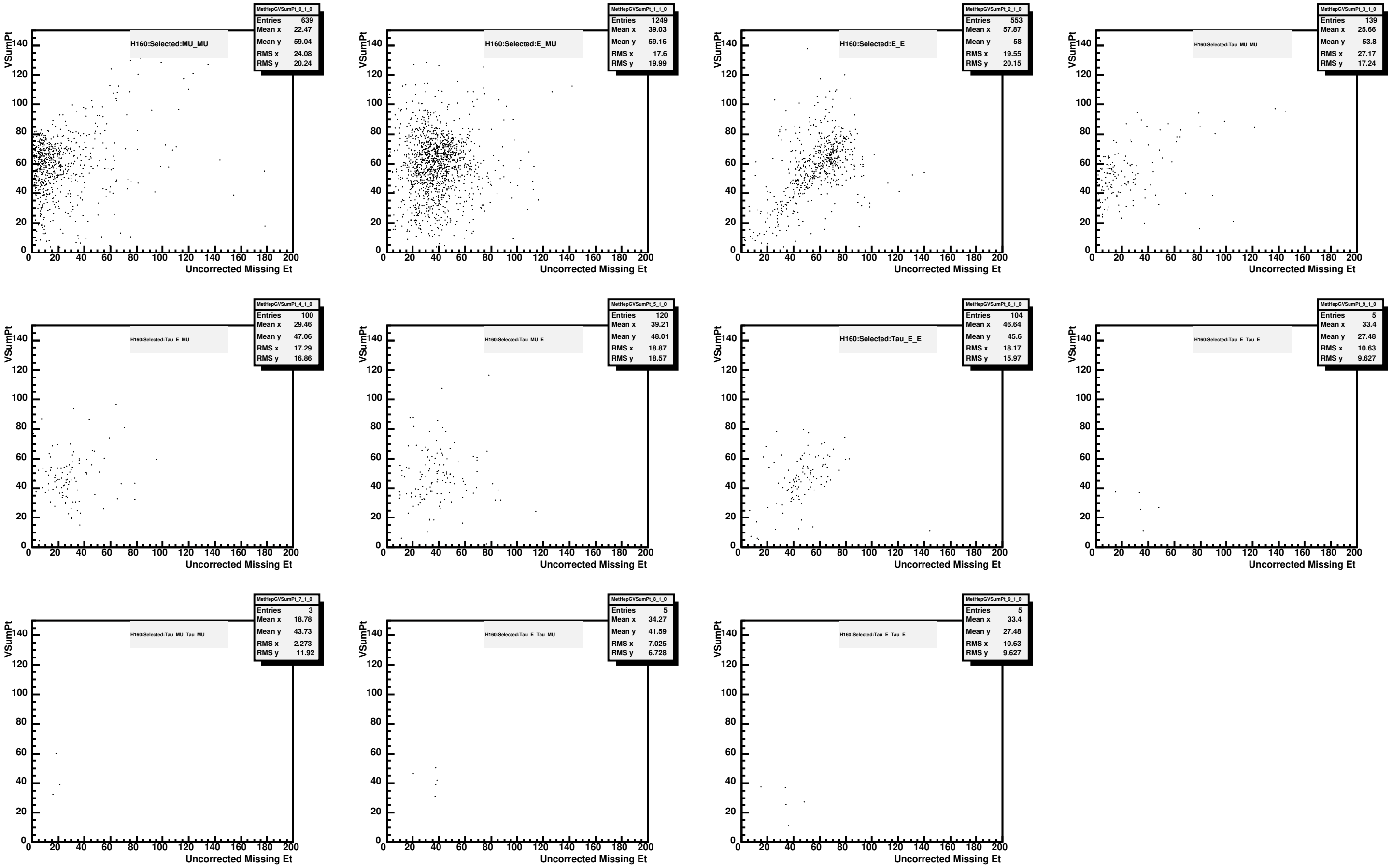
Hepg Lead Pt vs JPMC MET Rejected

$$M_{Higgs} = 160$$



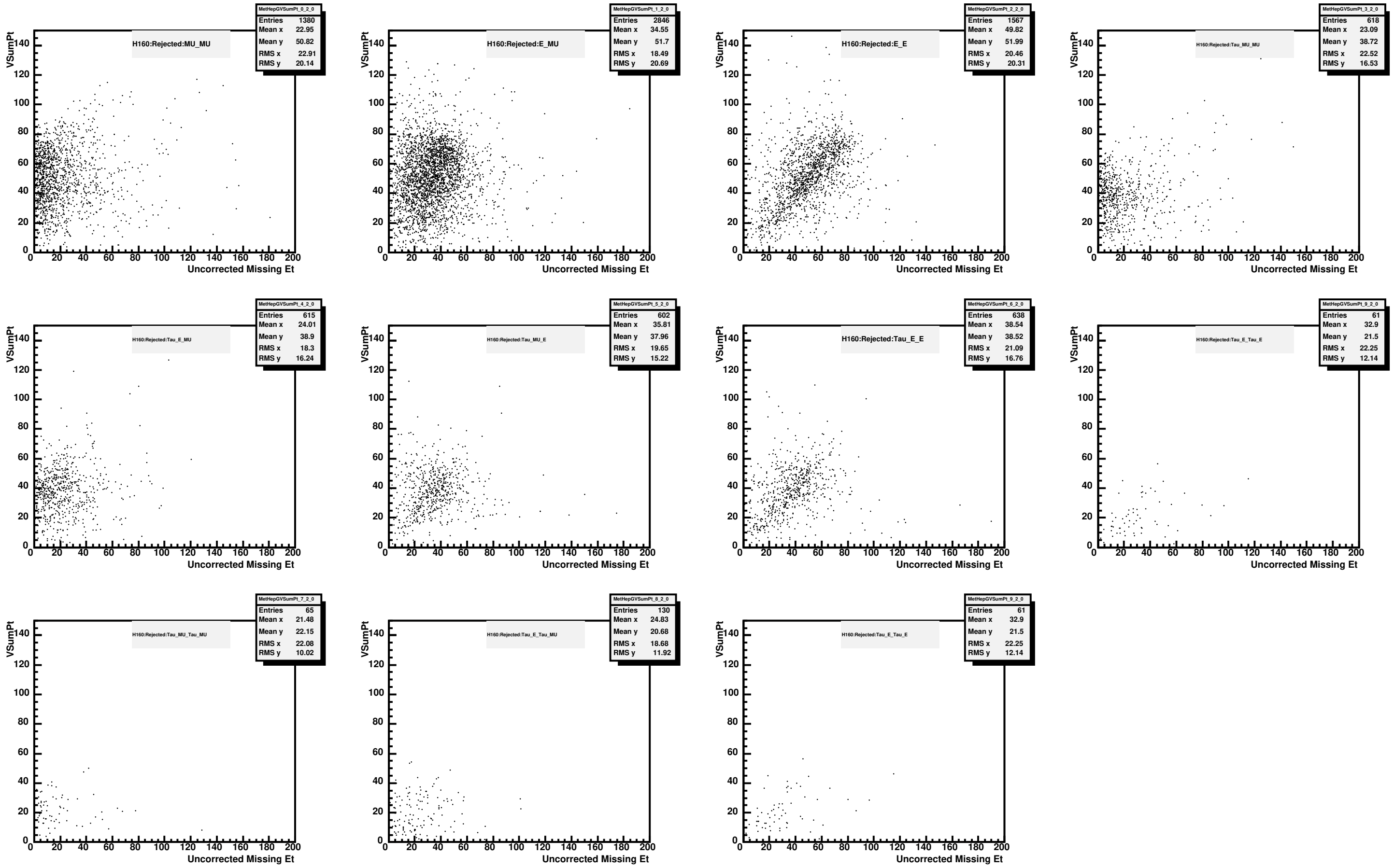
Hepg VSumPt vs Uncor MET

Selected$M_{Higgs} = 160$



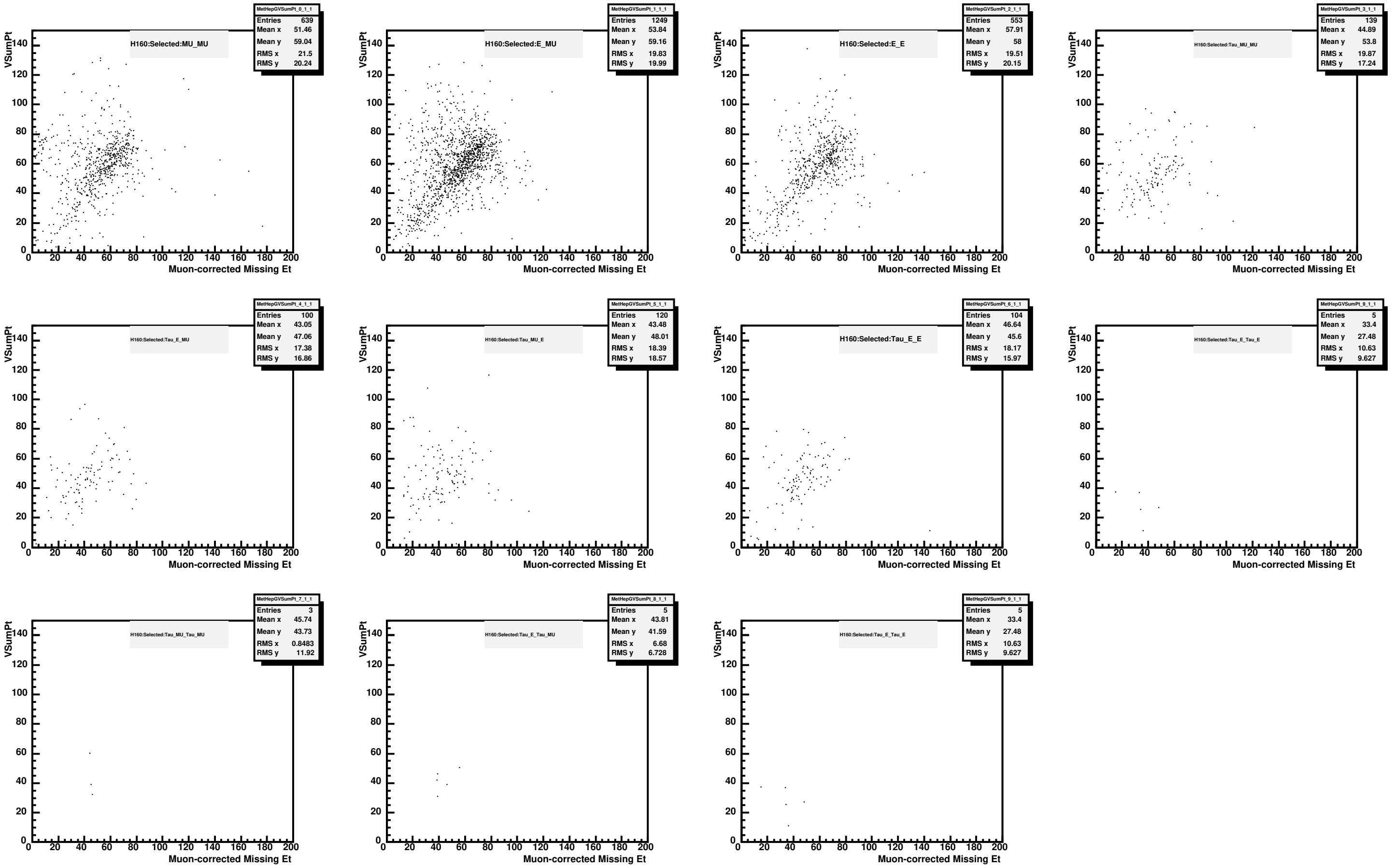
Hepg VSumPt vs Uncor MET Rejected

$$M_{Higgs} = 160$$



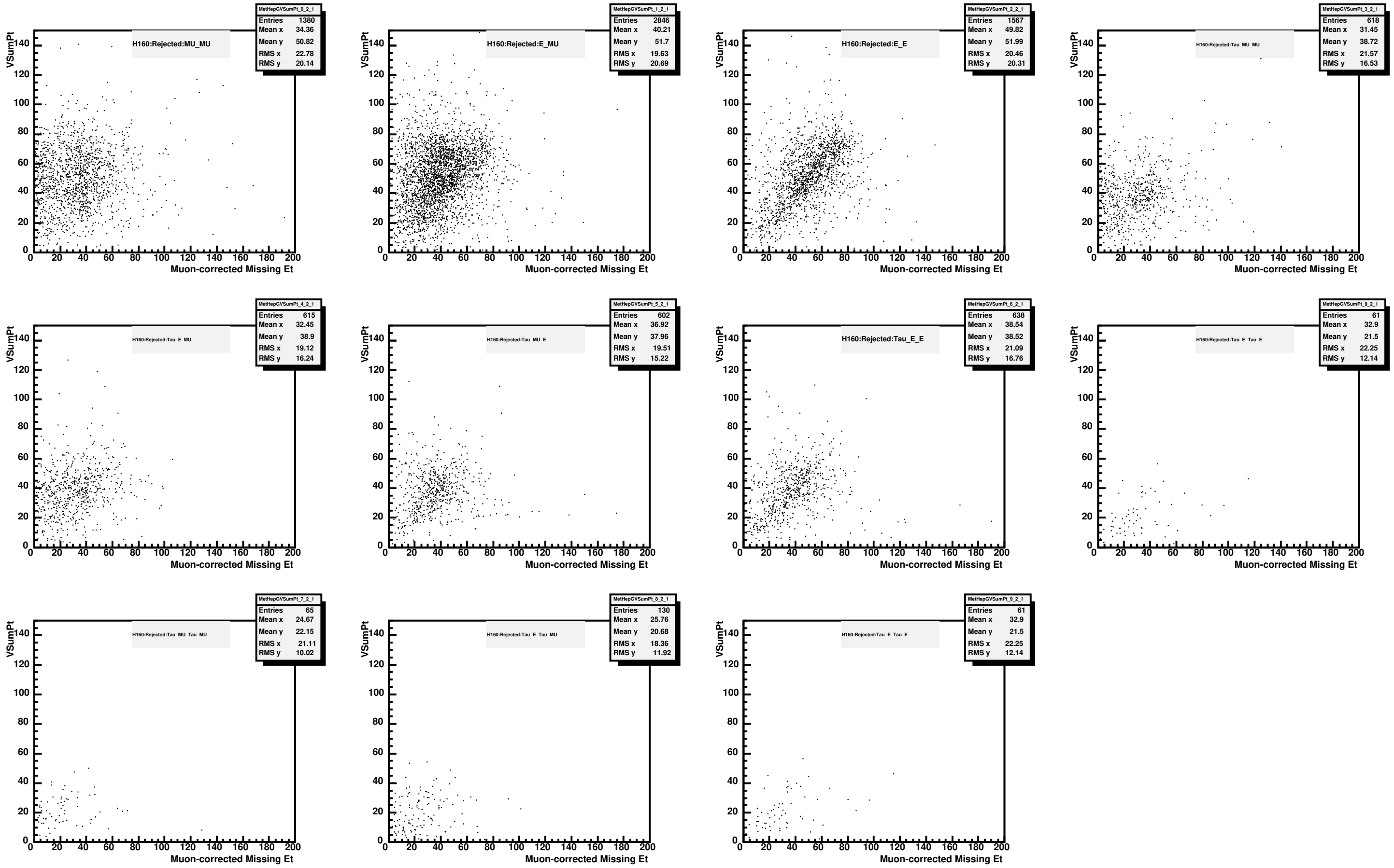
Hepg VSumPt vs MU MET

Selected$M_{Higgs} = 160$



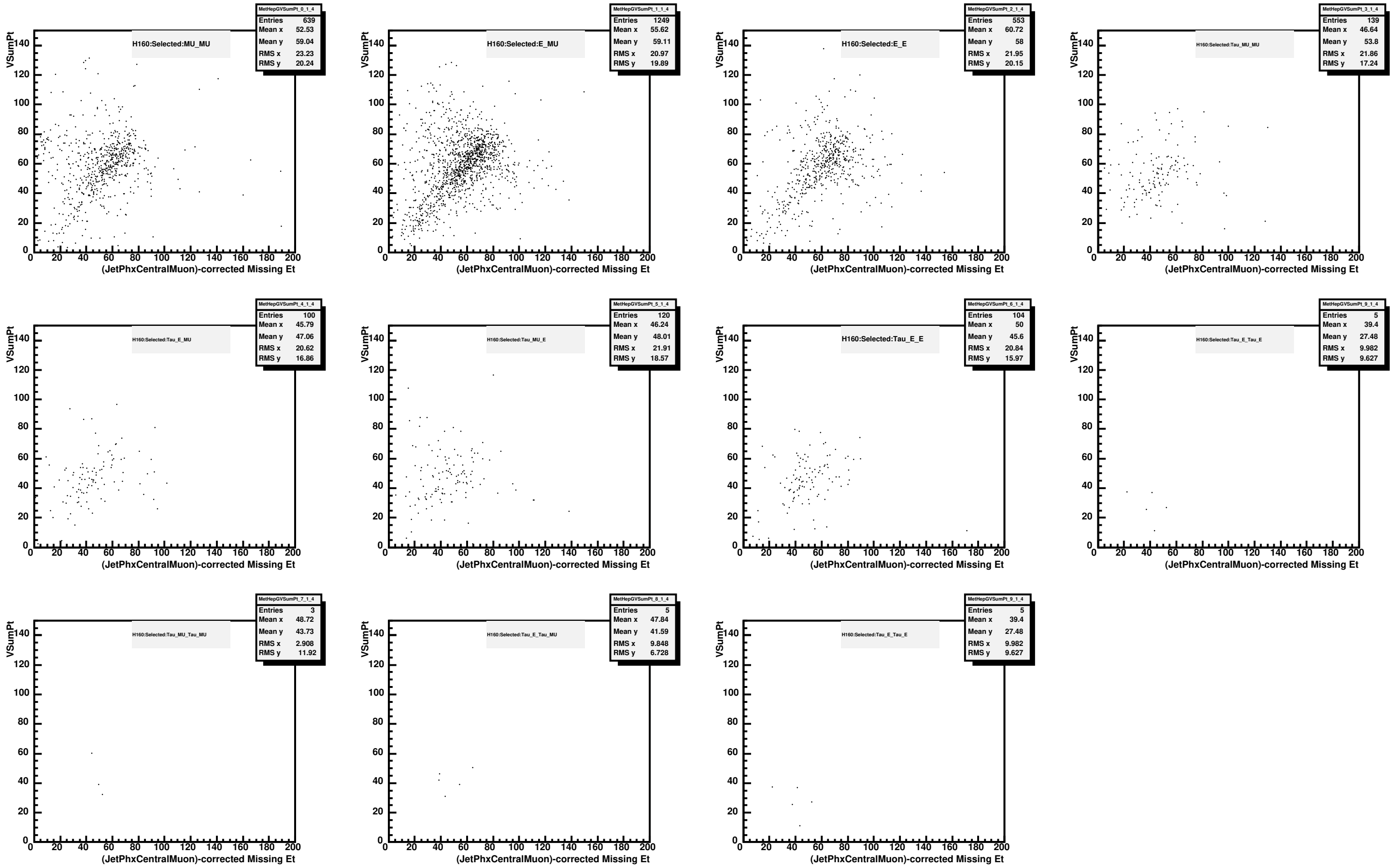
Hepg VSumPt vs MU MET Rejected

$$M_{Higgs} = 160$$



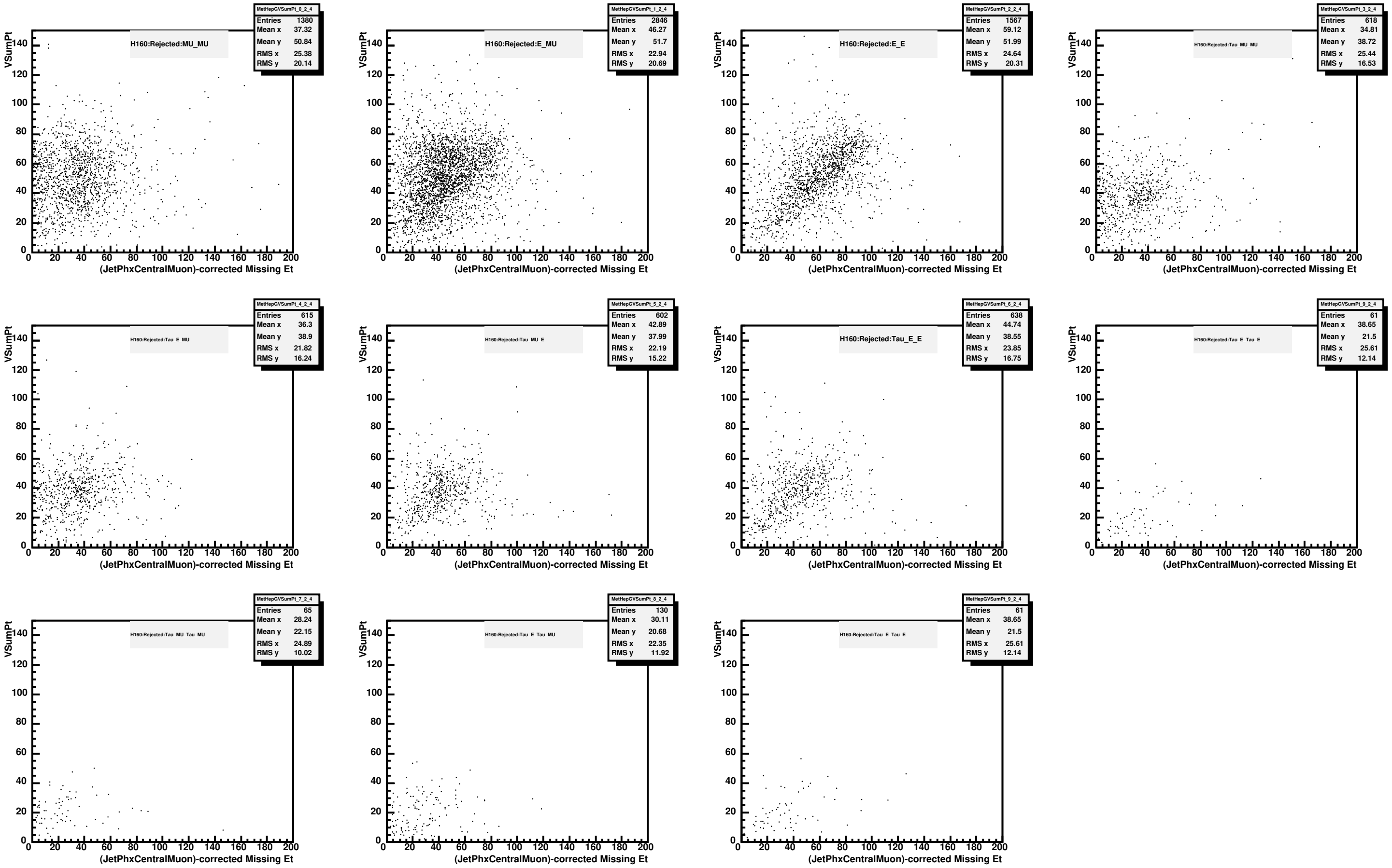
Hepg VSumPt vs JPMC

Selected$M_{Higgs} = 160$



Hepg VSumPt vs JPMC Rejected

$$M_{Higgs} = 160$$



Met Corrections

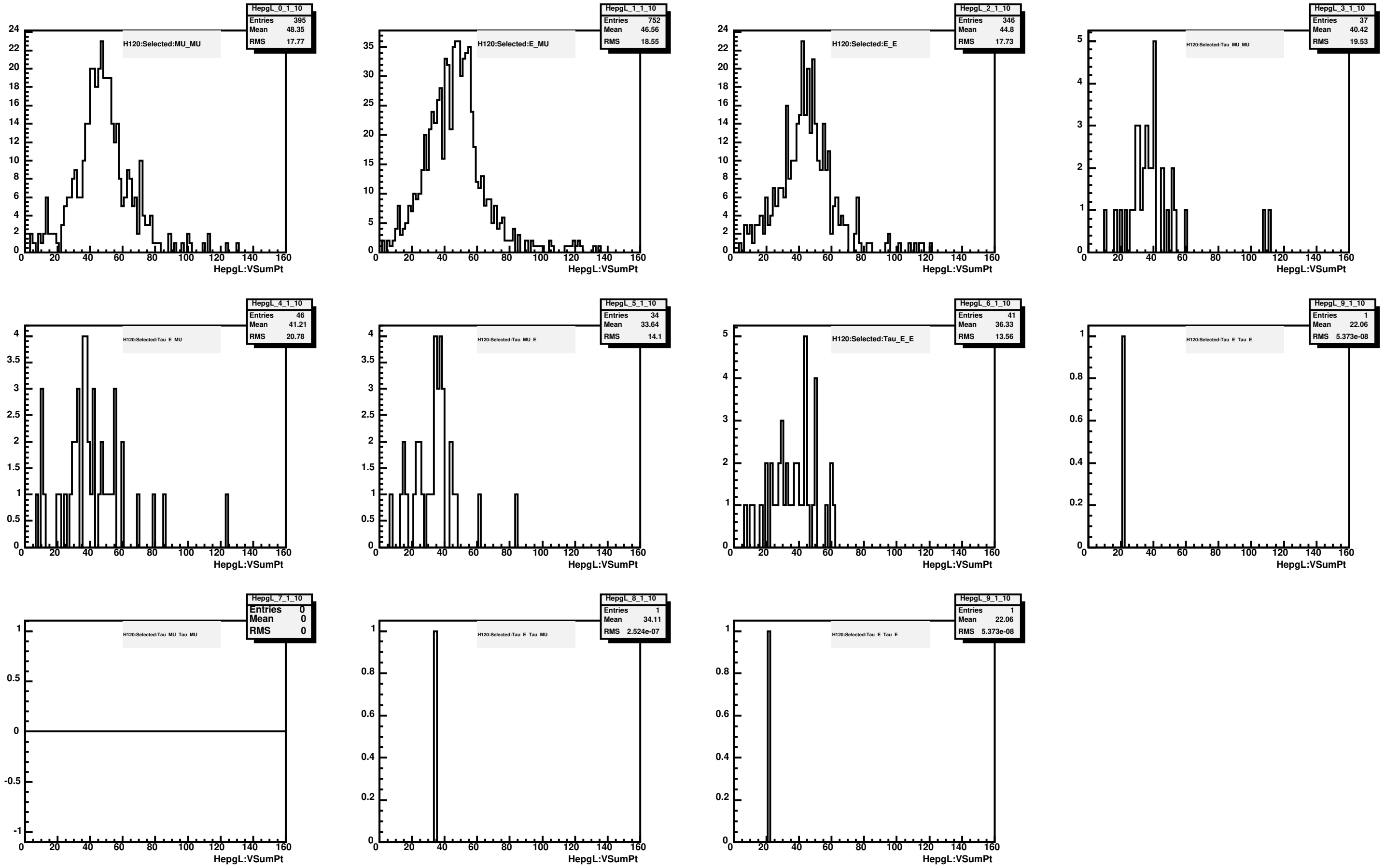
- The Raw Met in $\mu\mu$ events is very low. Suggest to *remove* residual muon contribution to get an estimate of the ISR.
- Leave the jets in place – make no correction to MET, again to get ISR
- Following from this, should remove the electron energy from the MET computation
- Need to look at a Hepg ISR estimator vs the MET
- This computes boost of Higgs and hence is a measure of Higgs Pt.
- Can correct $\Delta\phi_{ll}$ for this

$M_{Higgs} = 120$ **GeV/c^2**

- Same slides as for $M_{Higgs} = 160$ GeV/c^2

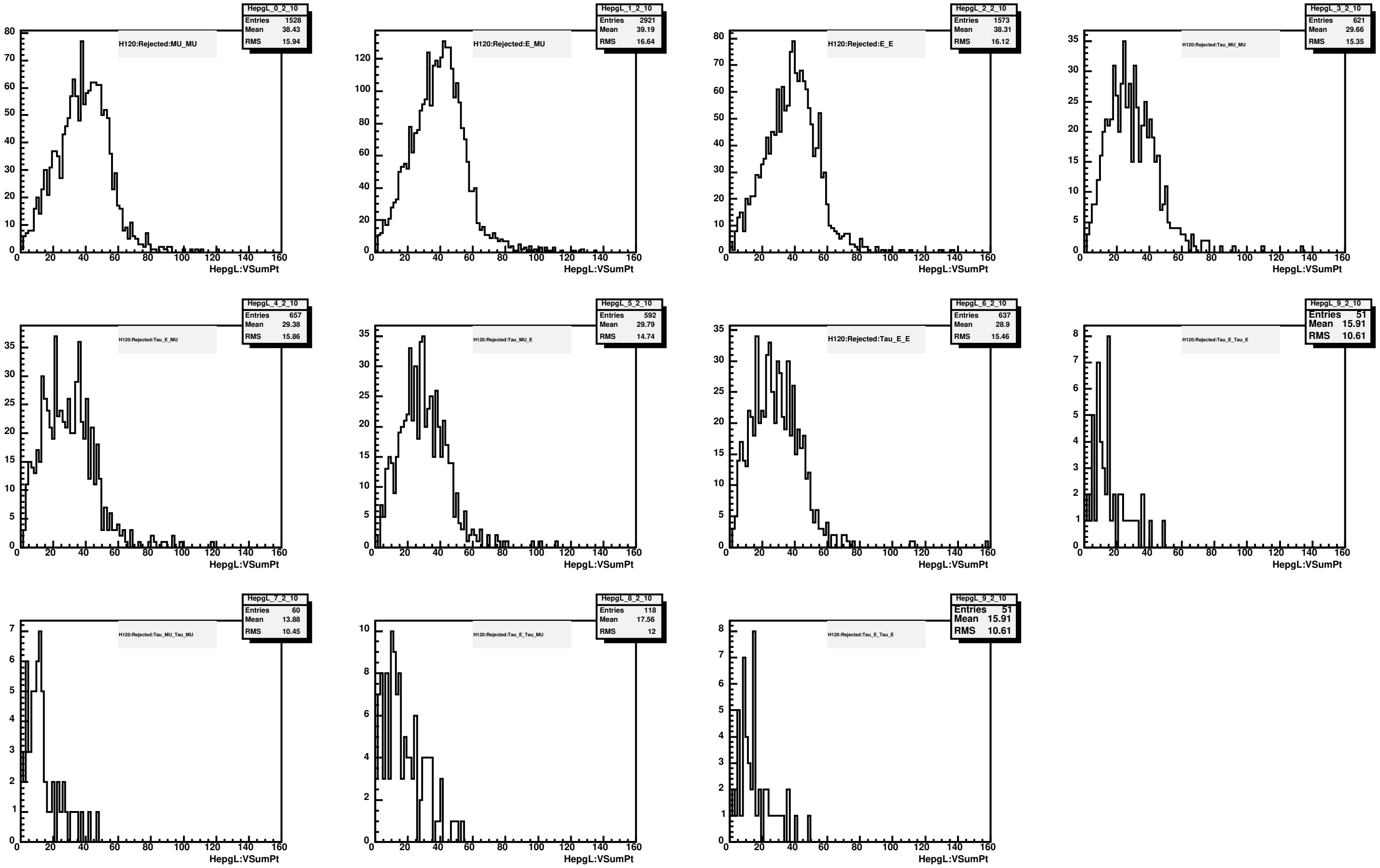
Kinematics: HepG: VSumPt Selected

$$M_{Higgs} = 120$$

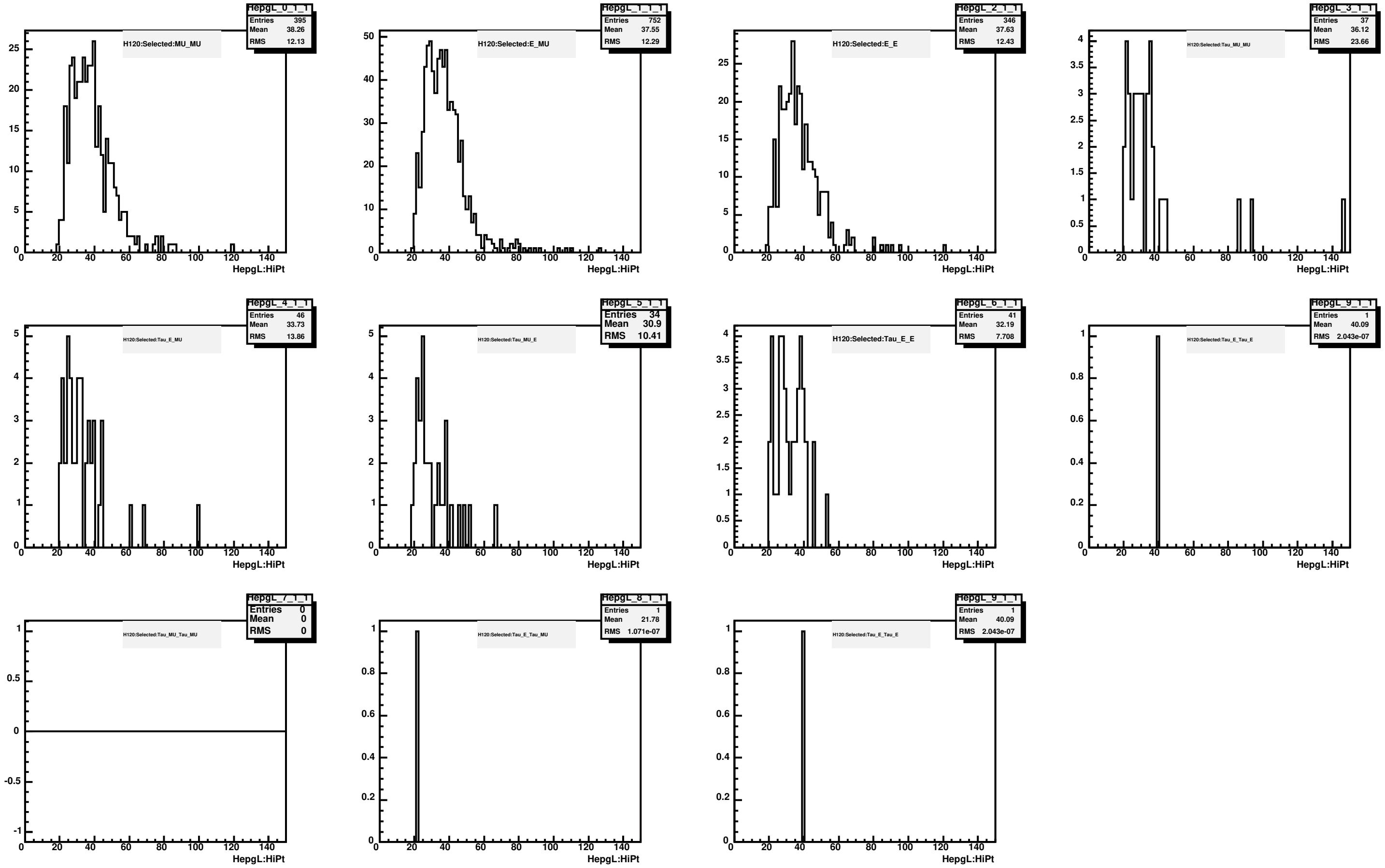


Kinematics: HepG: VSumPt Rejected

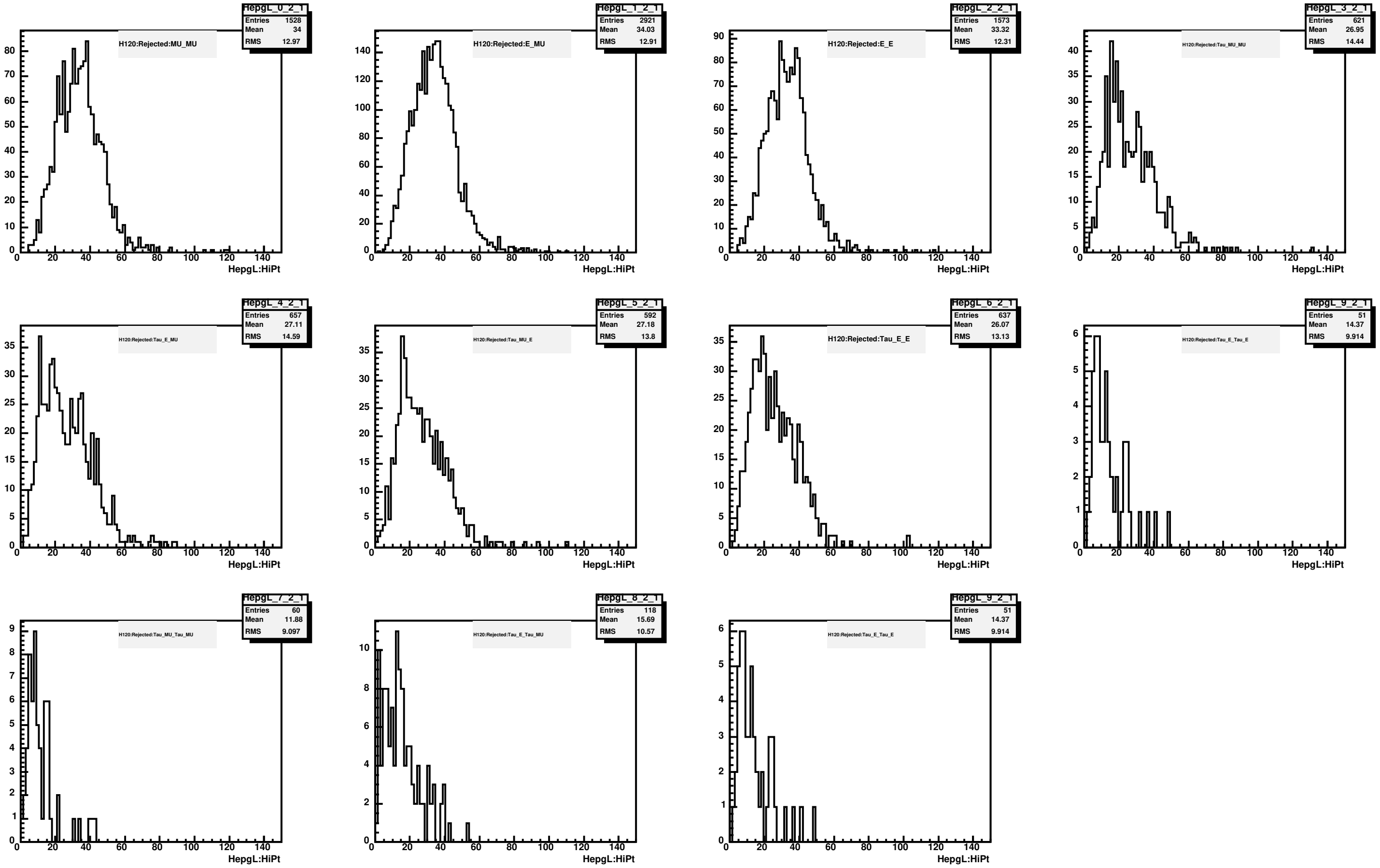
$$M_{Higgs} = 120$$



Kinematics: HepG: Leading Lepton Pt
Selected $M_{Higgs} = 120$

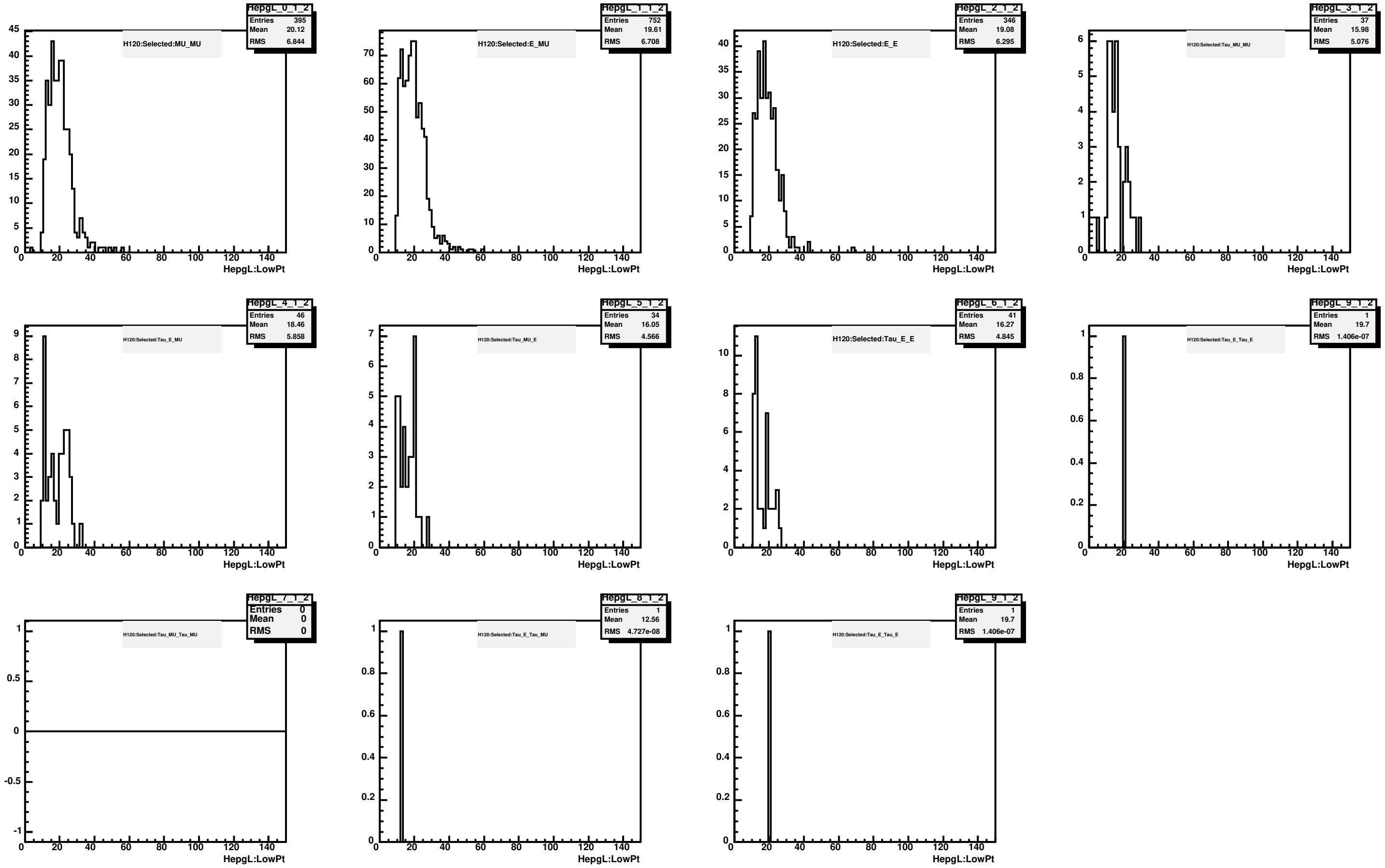


Kinematics: HepG: Leading Lepton Pt Rejected $M_{Higgs} = 120$



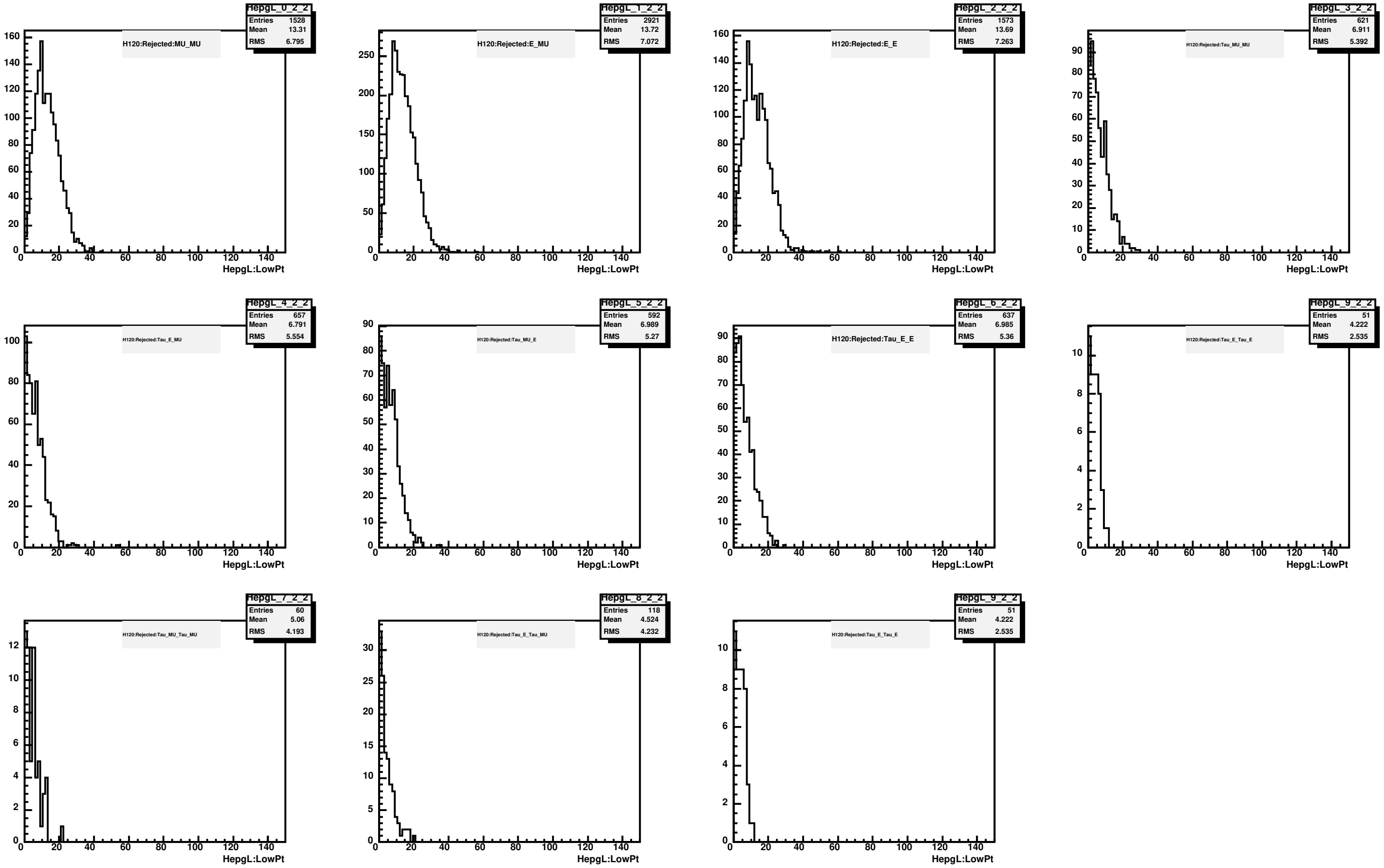
Kinematics: HepG: Subleading Lepton Pt

Selected $M_{Higgs} = 120$



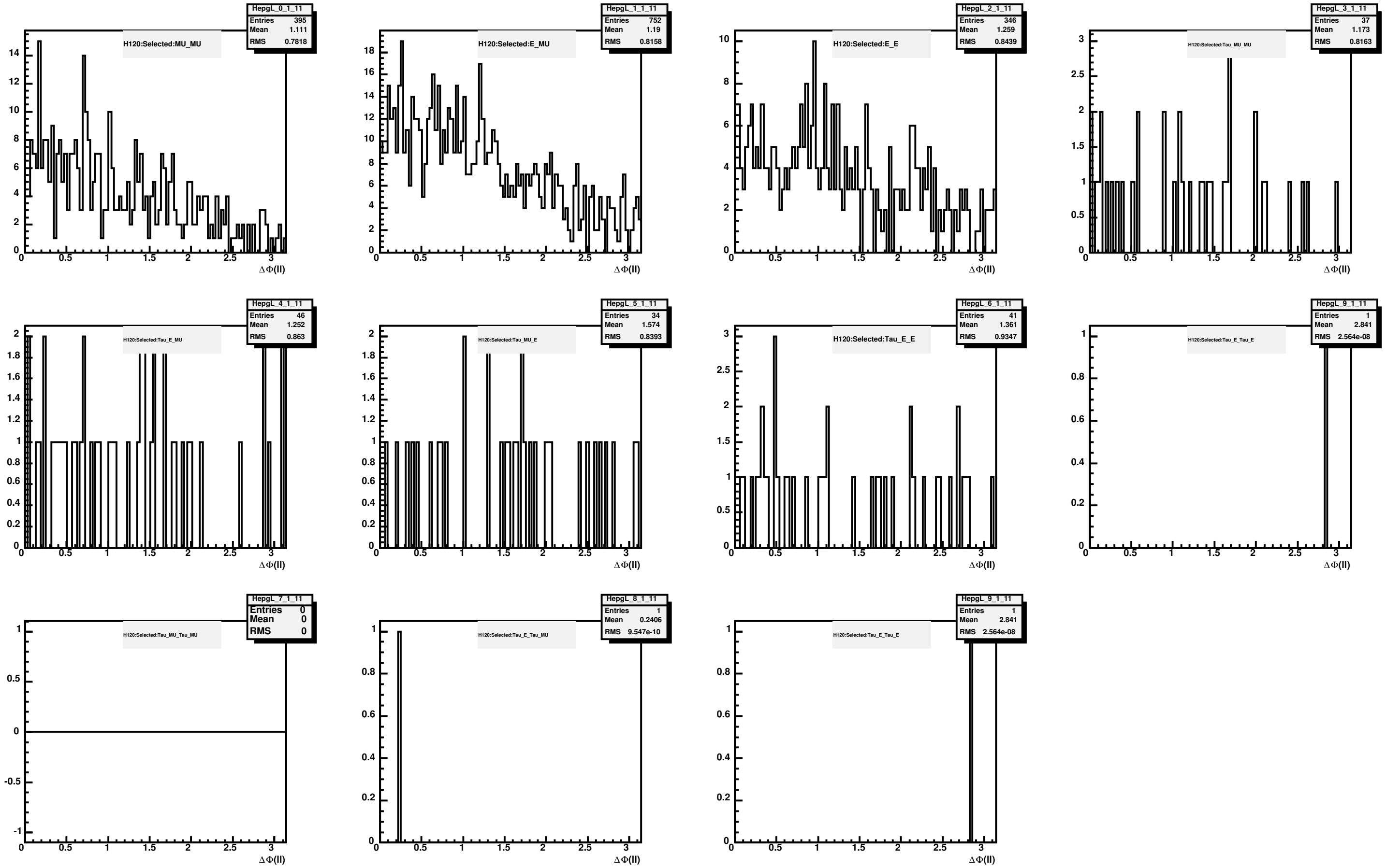
Kinematics: HepG: Subleading Lepton Pt

Rejected $M_{Higgs} = 120$



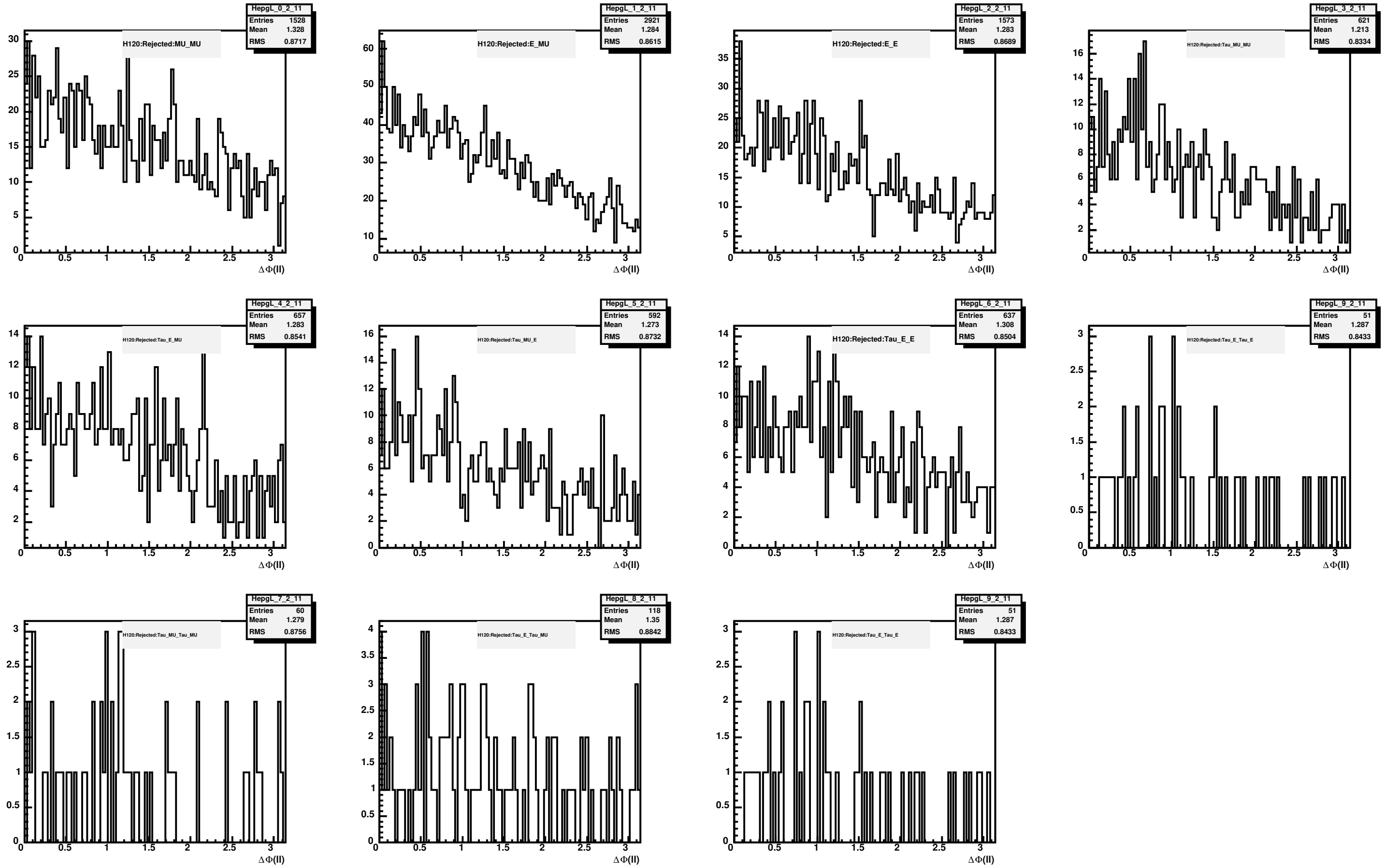
Kinematics: HepG: $\Delta\phi_{ll}$ Selected

$$M_{Higgs} = 120$$



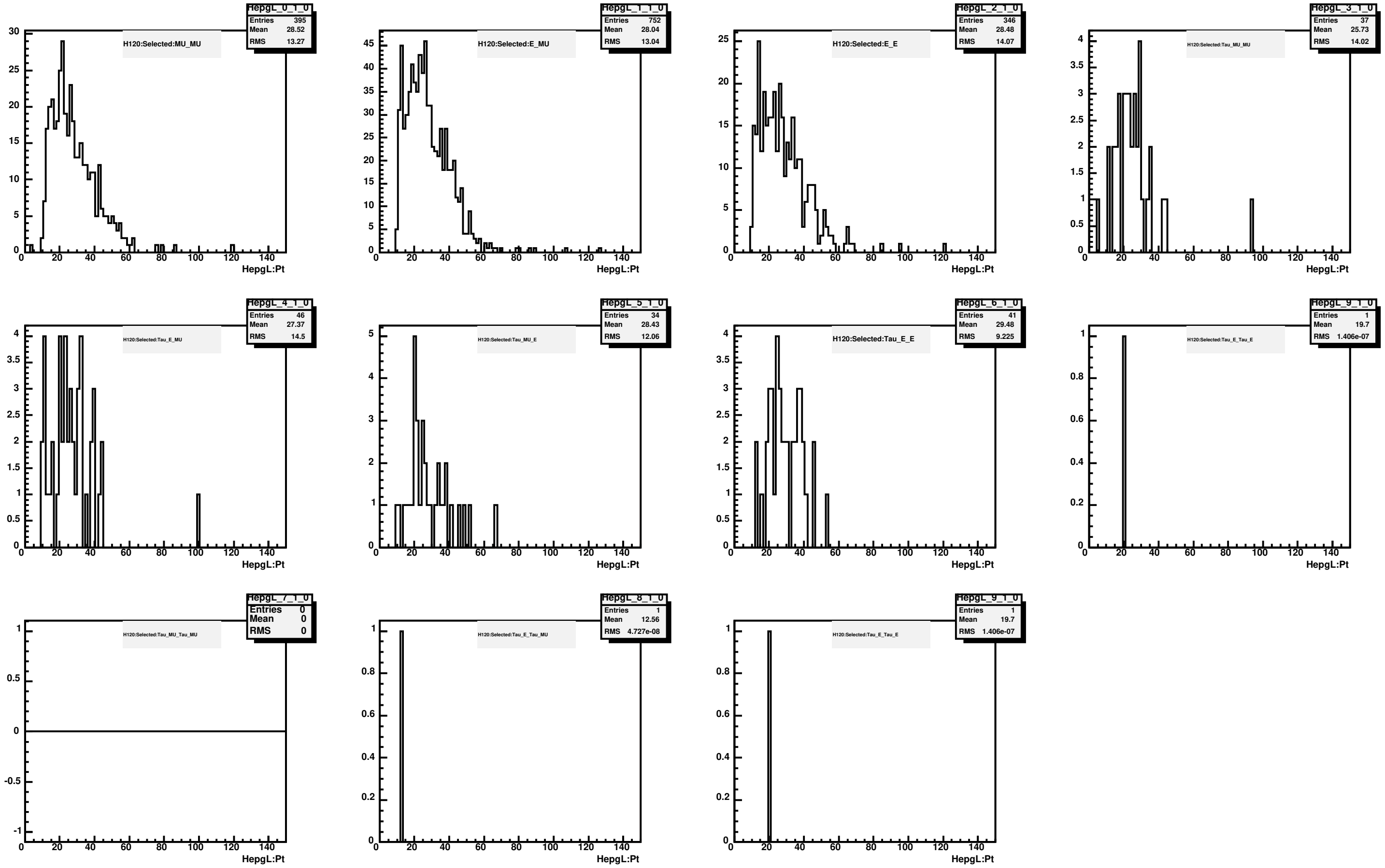
Kinematics: HepG: $\Delta\phi_{ll}$ Rejected

$$M_{Higgs} = 120$$



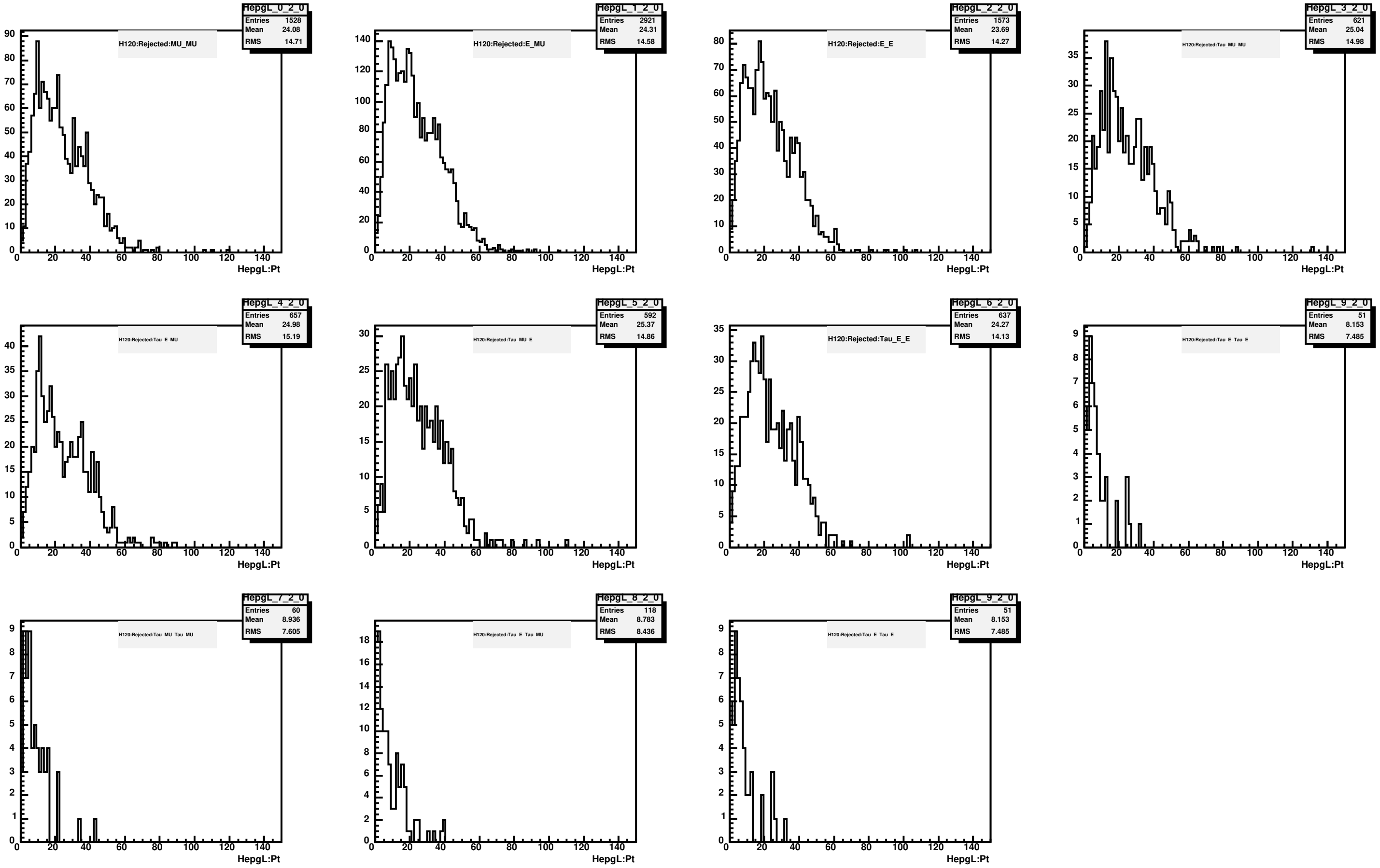
Kinematics: HepG: Pt1 Selected

$$M_{Higgs} = 120$$



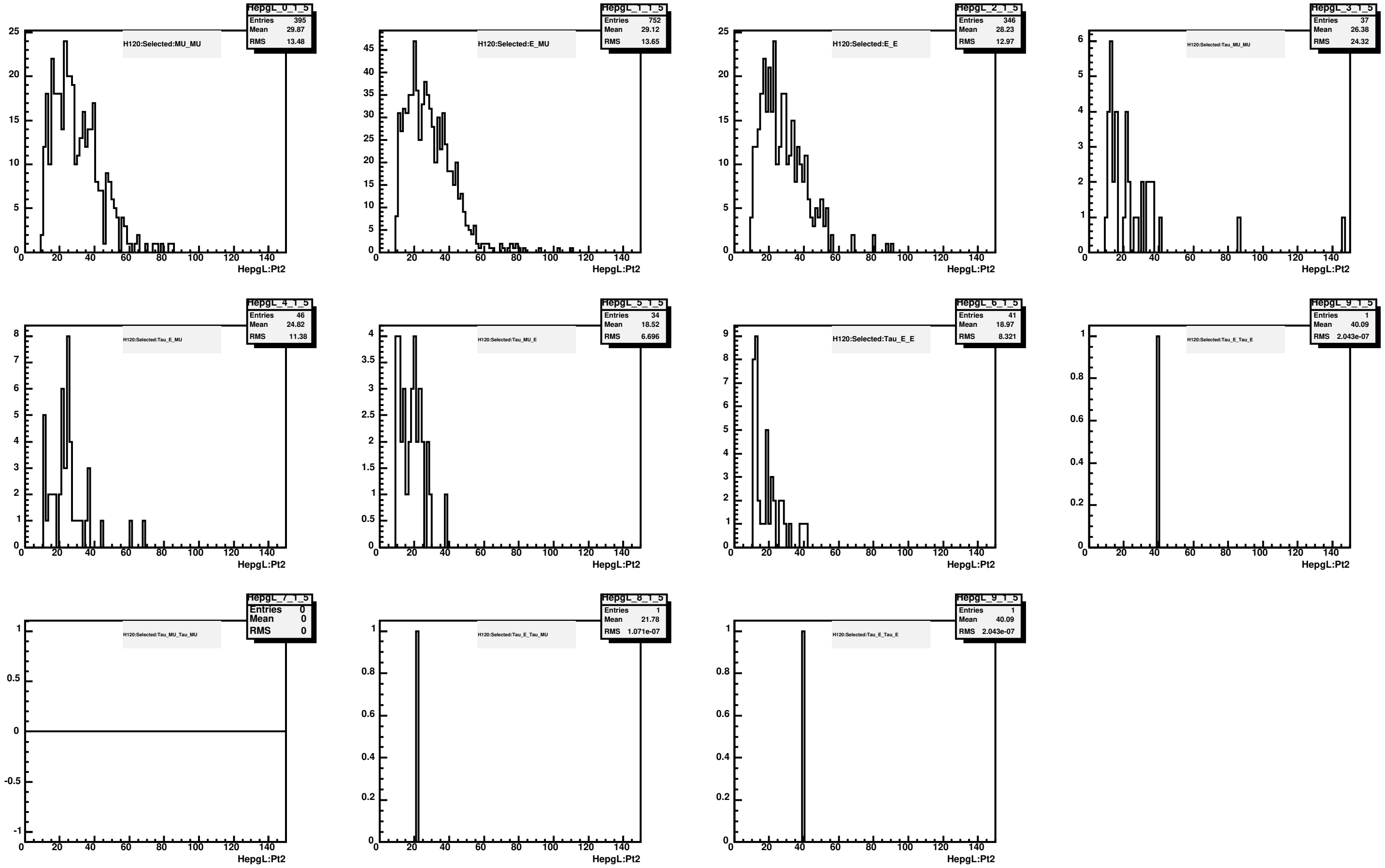
Kinematics: HepG: Pt1 Rejected

$$M_{Higgs} = 120$$

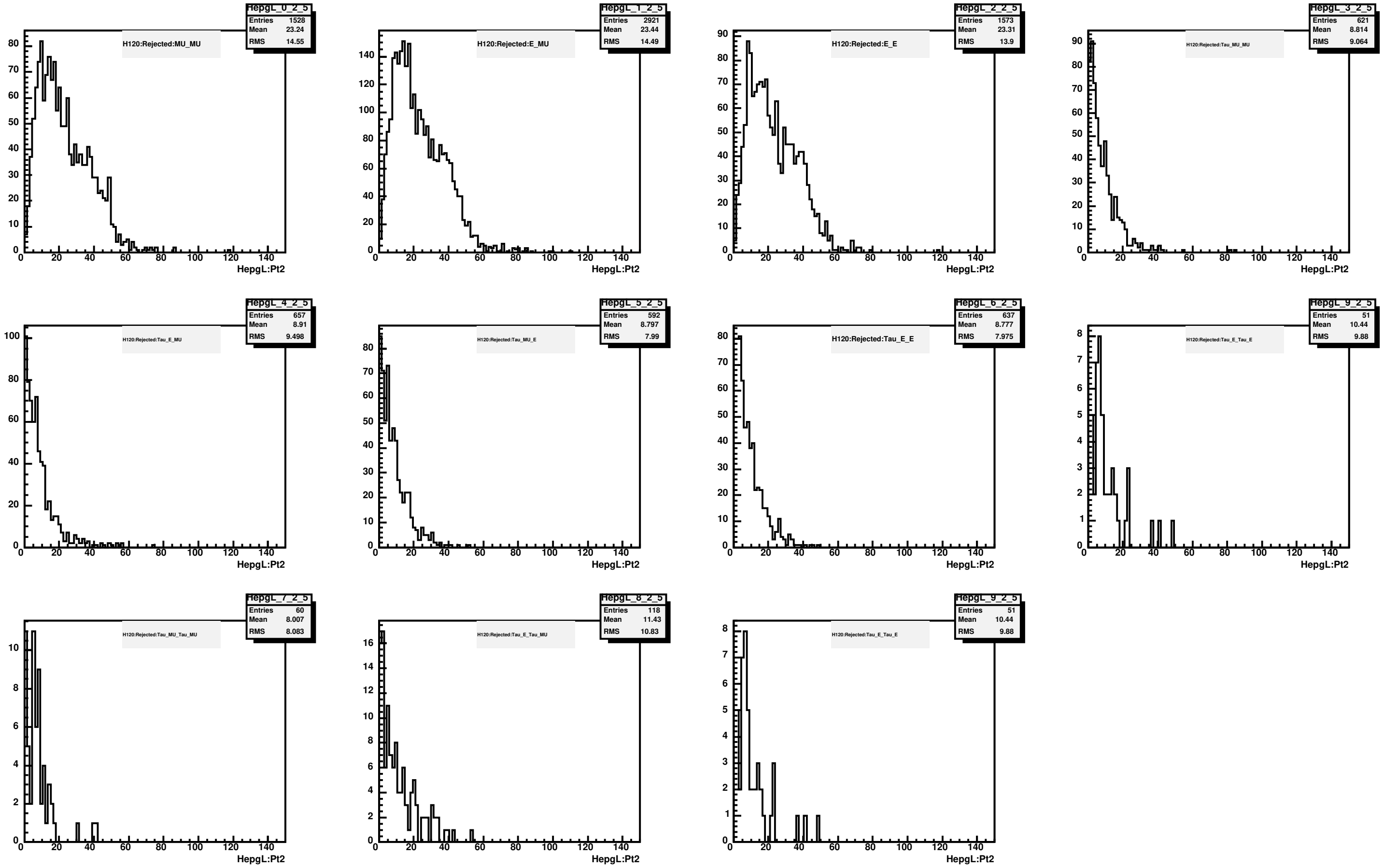


Kinematics: HepG: Pt2 (τ decay prod)

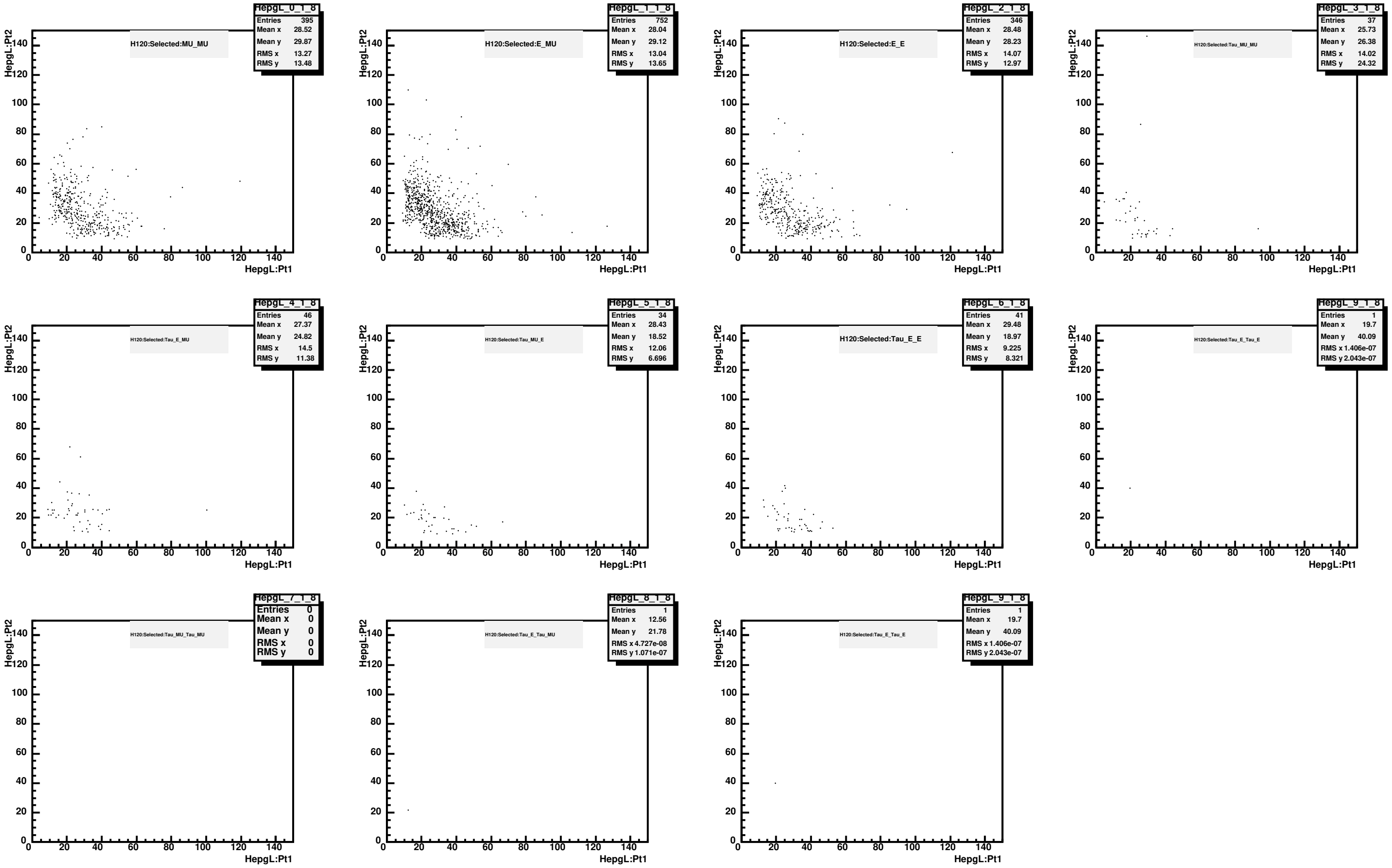
Selected $M_{Higgs} = 120$



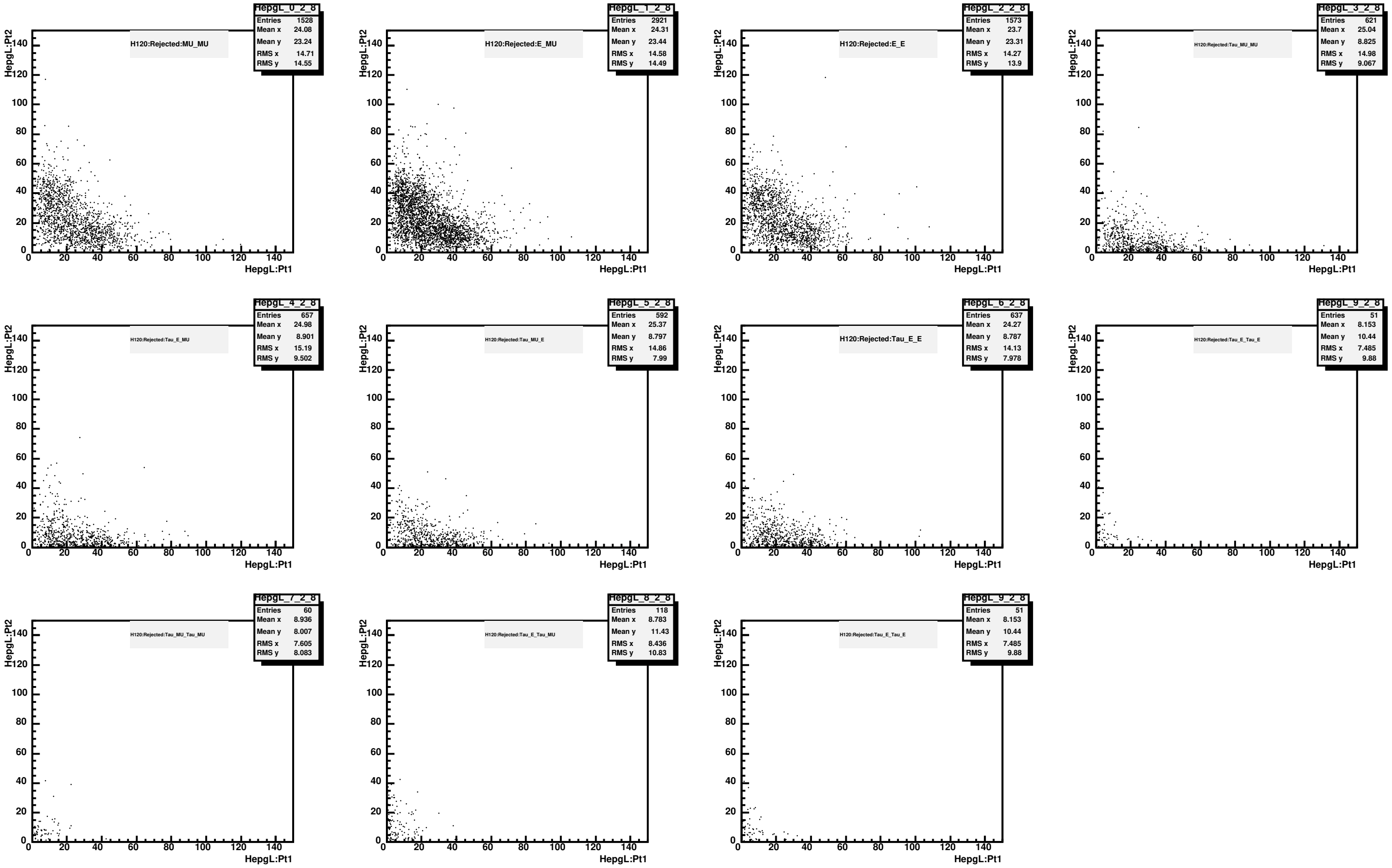
Kinematics: HepG: Pt2 (τ decay prod) Rejected $M_{Higgs} = 120$



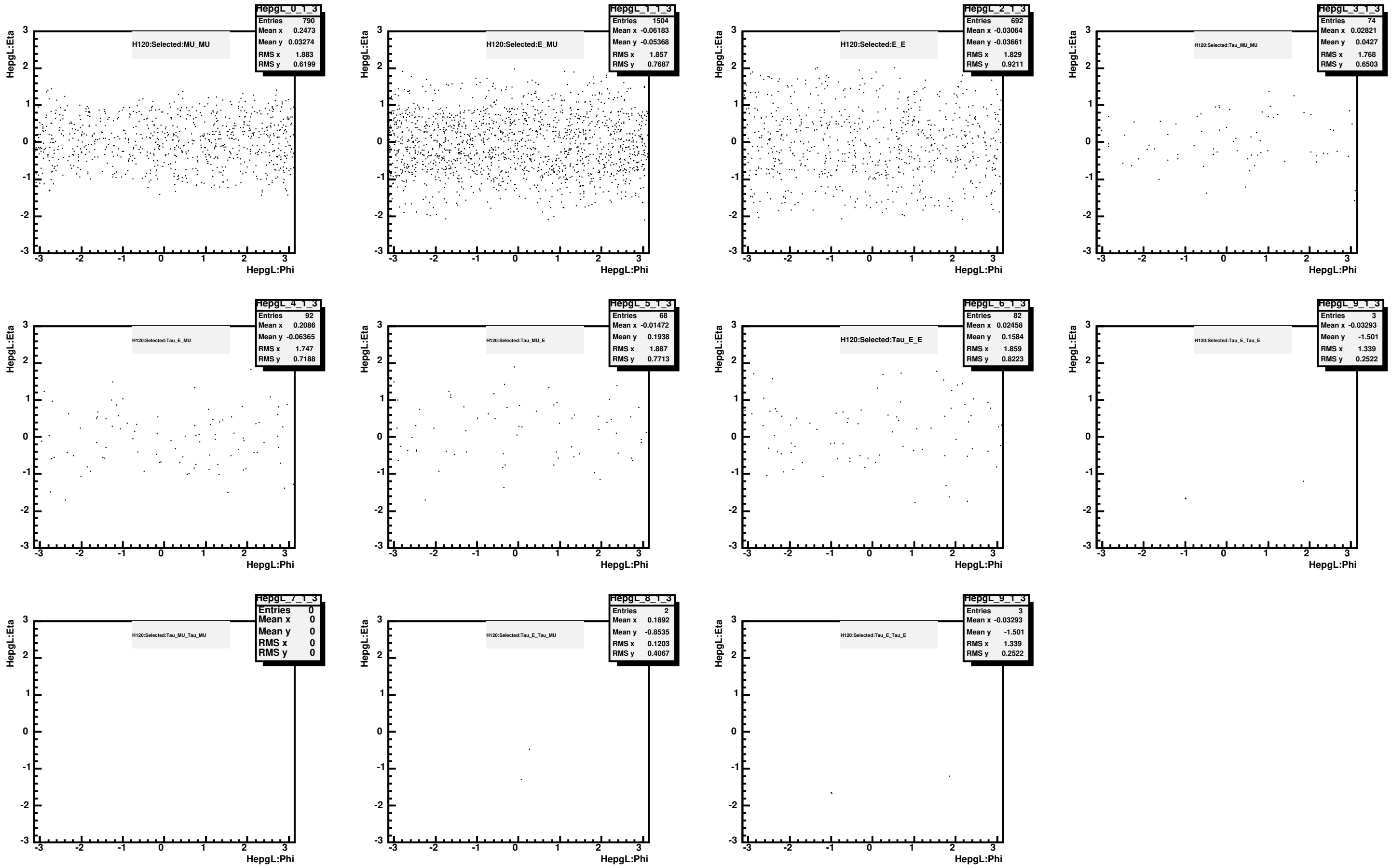
Kinematics: HepG: Pt1vs Pt2(τ decay prod) Selected $M_{Higgs} = 120$



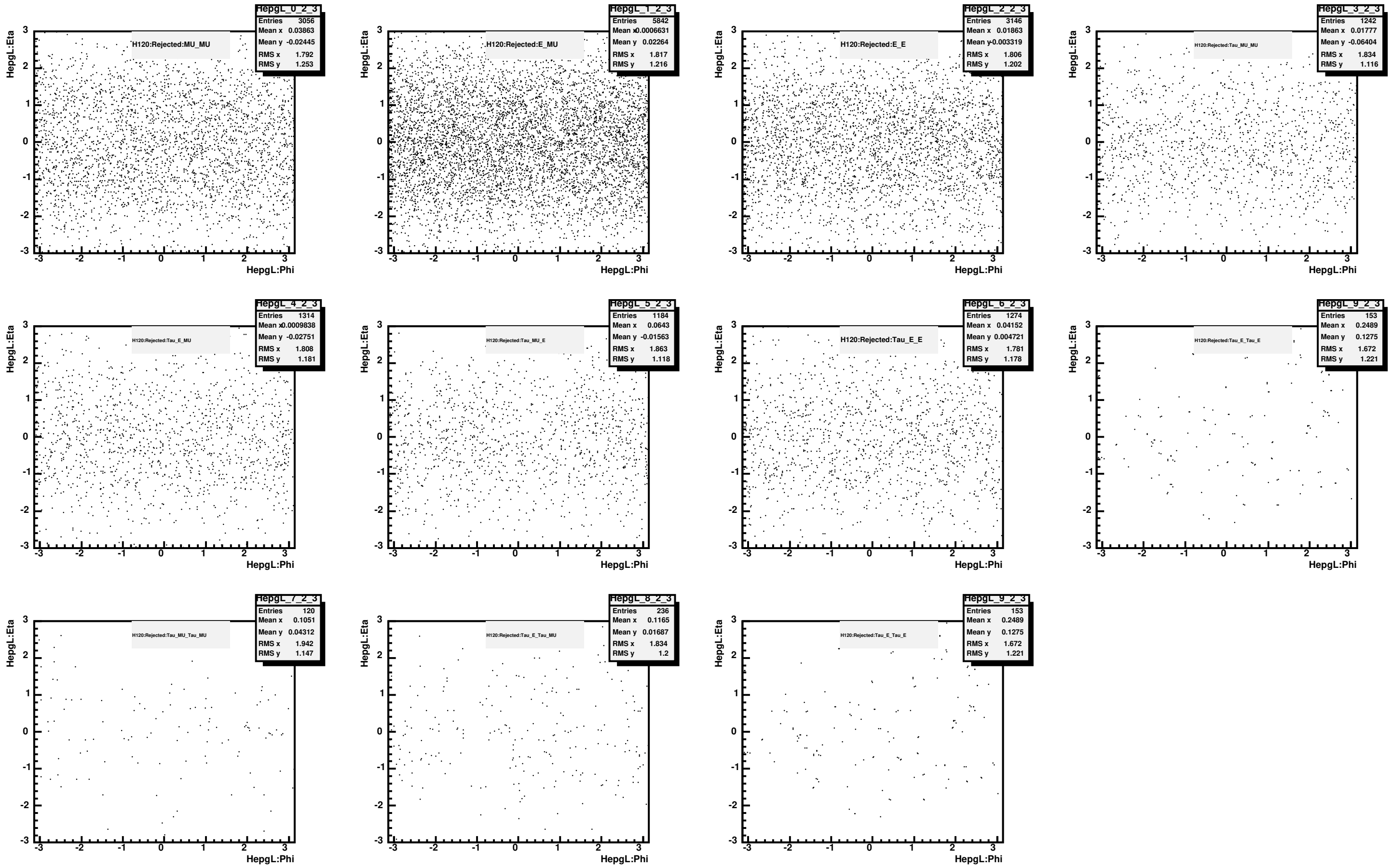
Kinematics: HepG: Pt1vs Pt2(τ decay prod) Rejected $M_{Higgs} = 120$



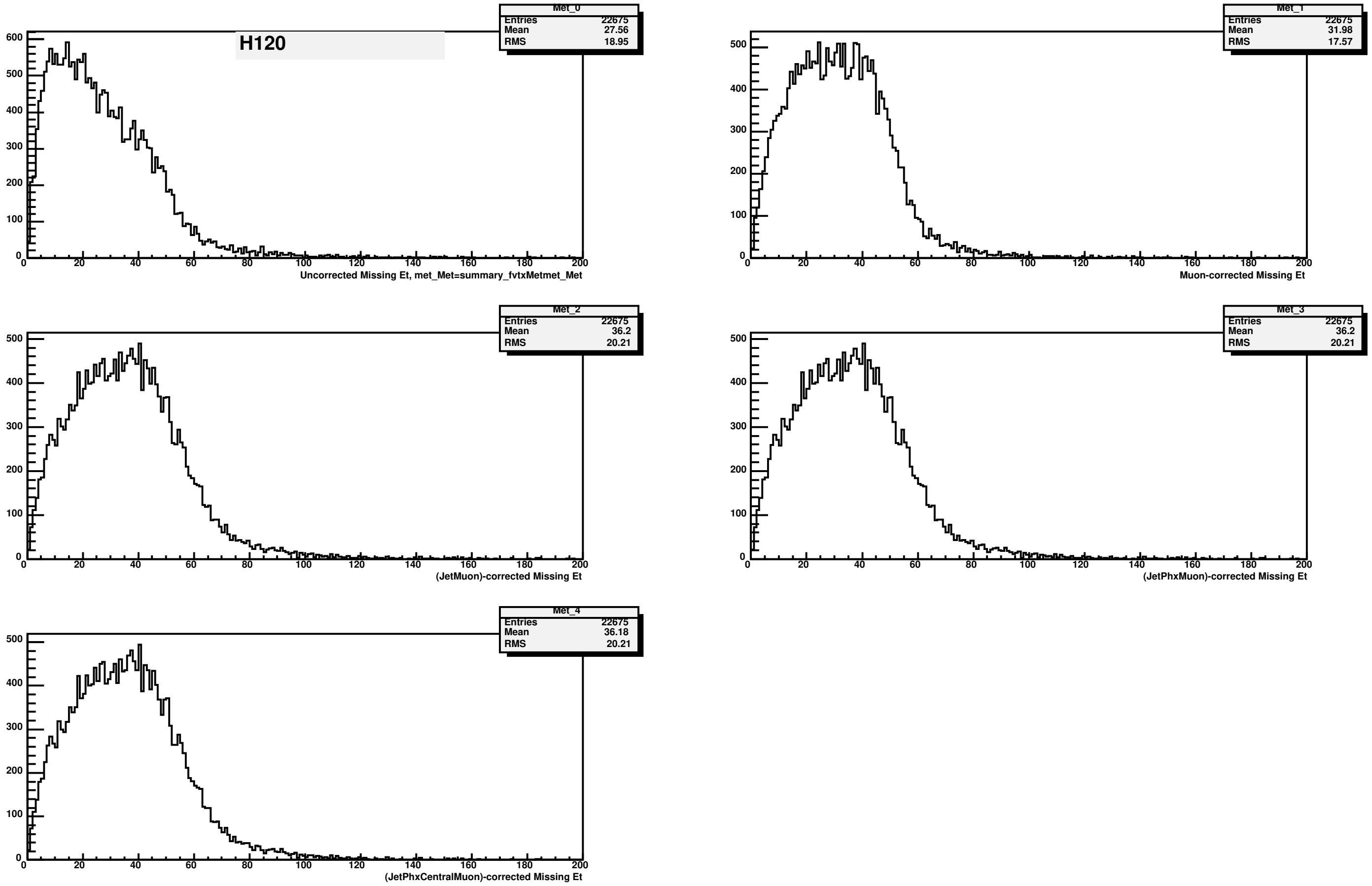
Kinematics: HepG: Selected $M_{Higgs} = 120$



Kinematics: HepG: Rejected $M_{Higgs} = 120$

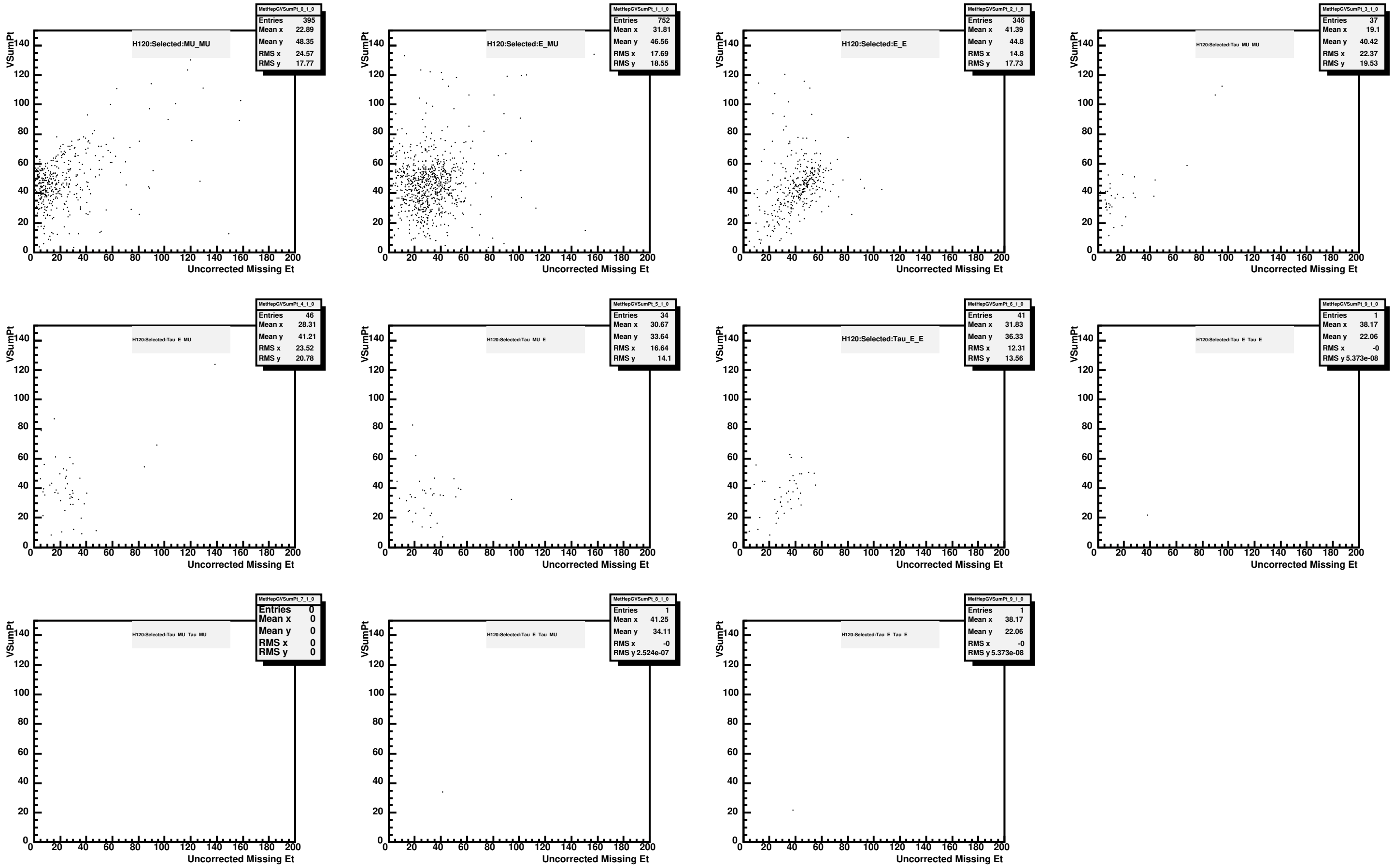


MET: Reconstructed: Raw $M_{Higgs} = 120$



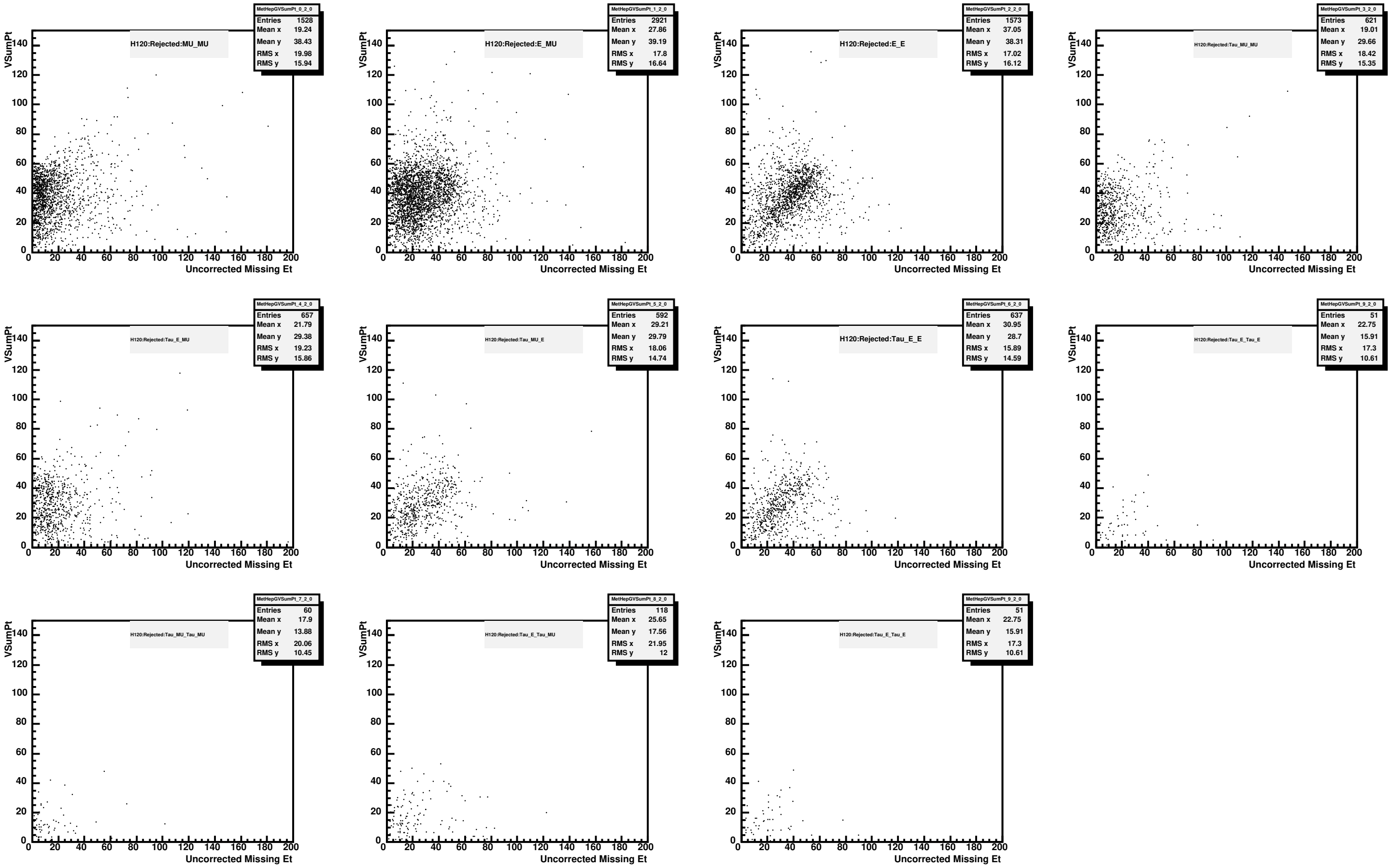
Hepg VSumPt vs Raw MET

Selected$M_{Higgs} = 160$



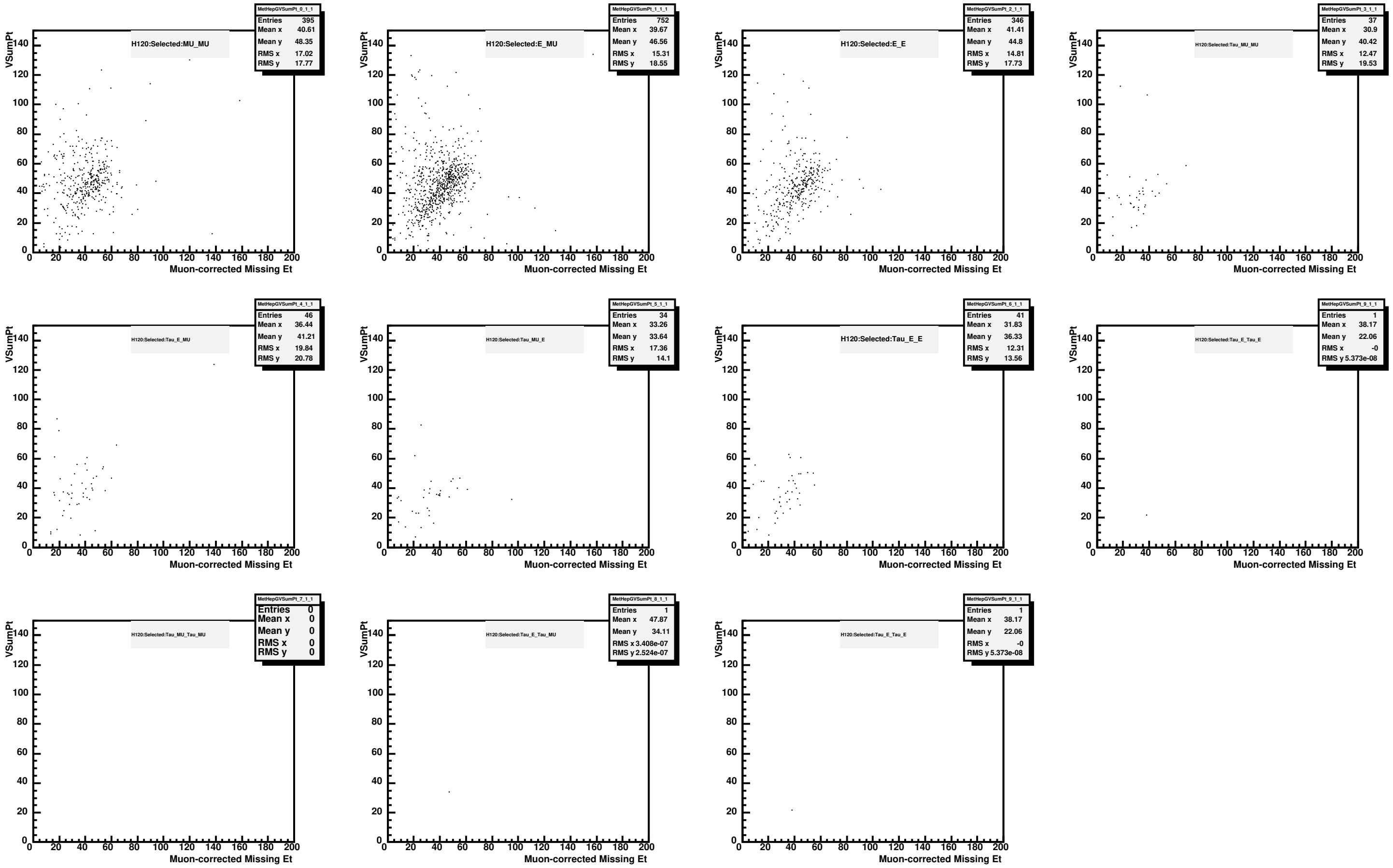
Hepg VSumPt vs Raw MET Rejected

$$M_{Higgs} = 160$$



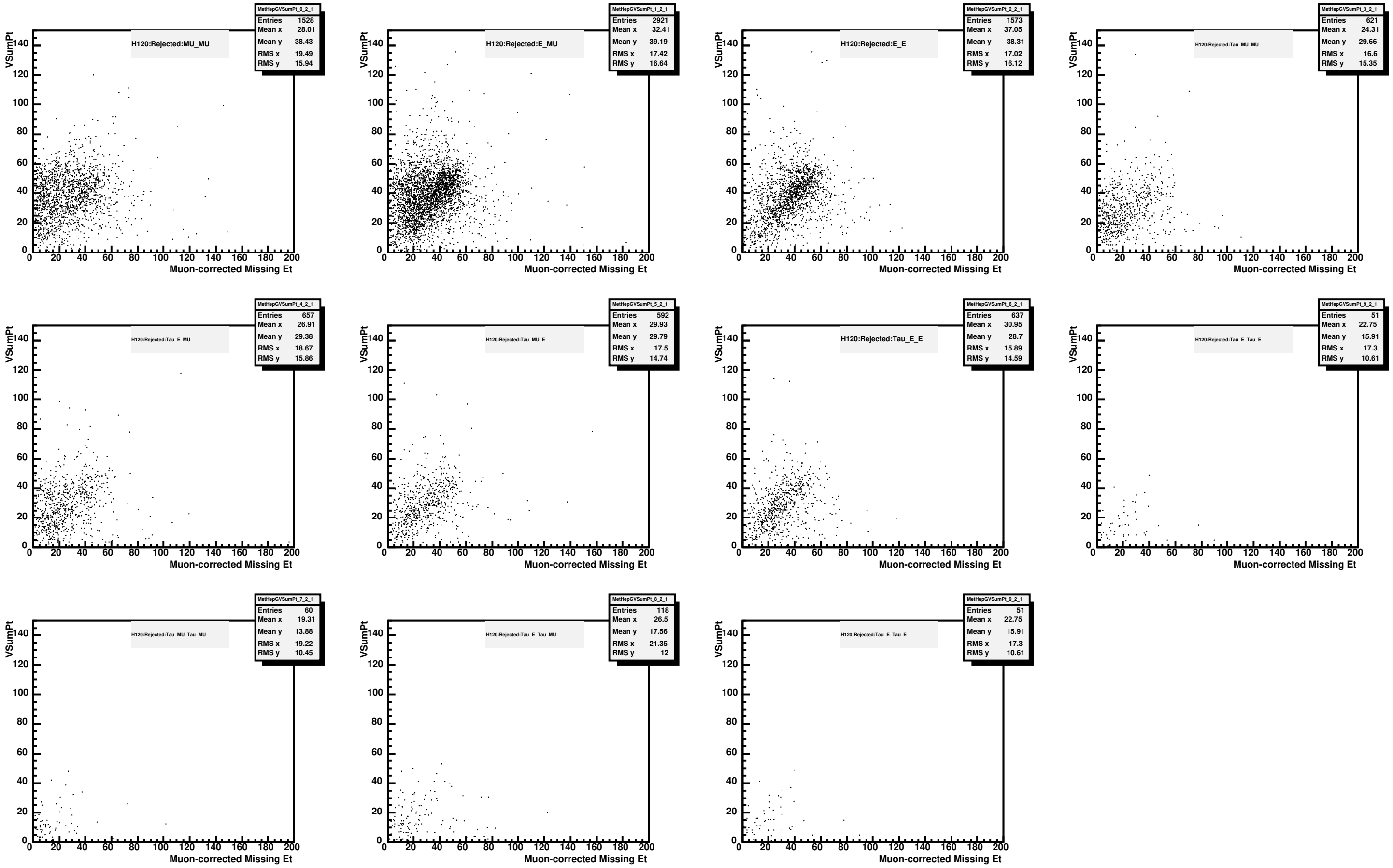
Hepg VSumPt vs Raw MET

Selected $M_{Higgs} = 160$

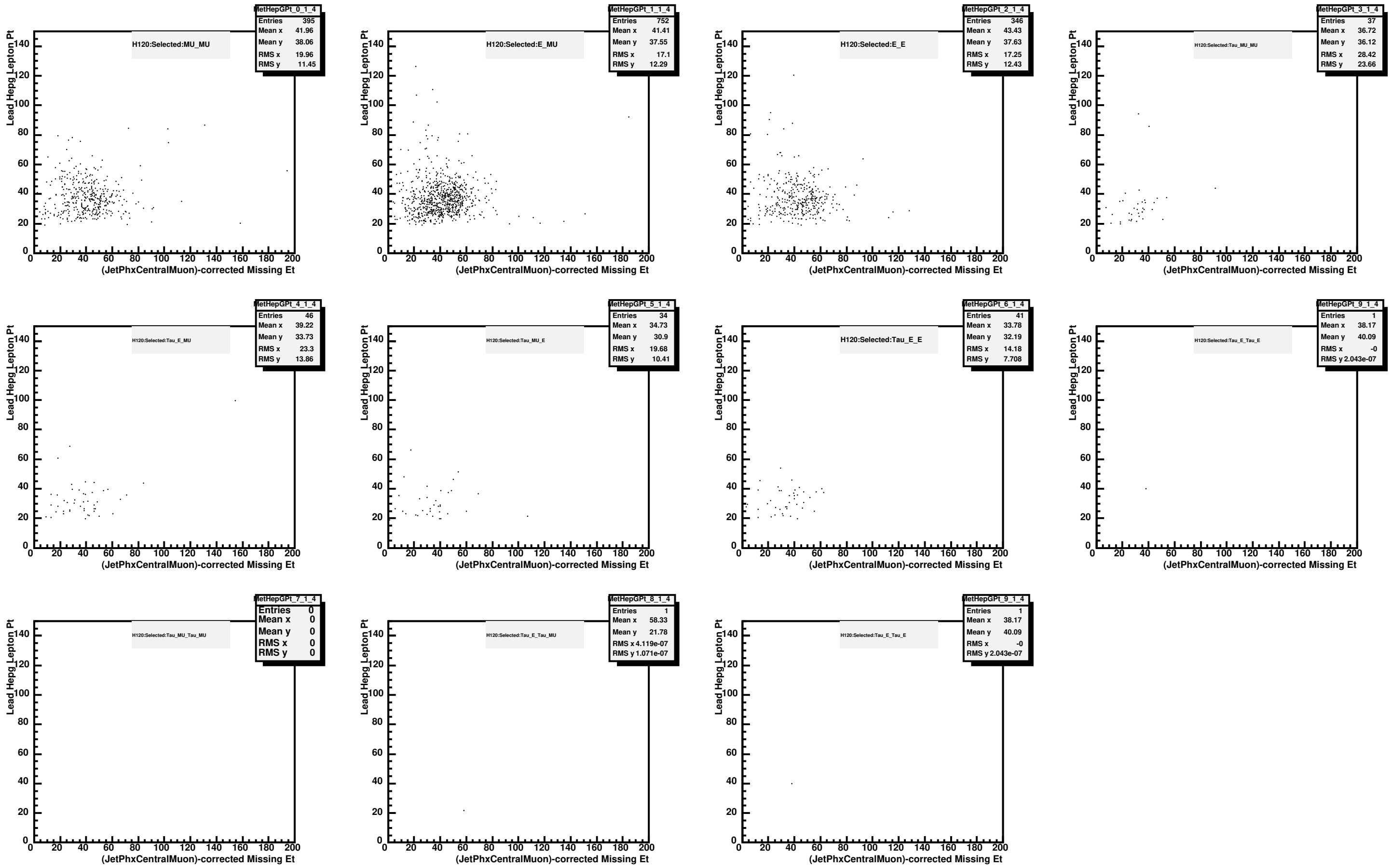


Hepg VSumPt vs Raw MET Rejected

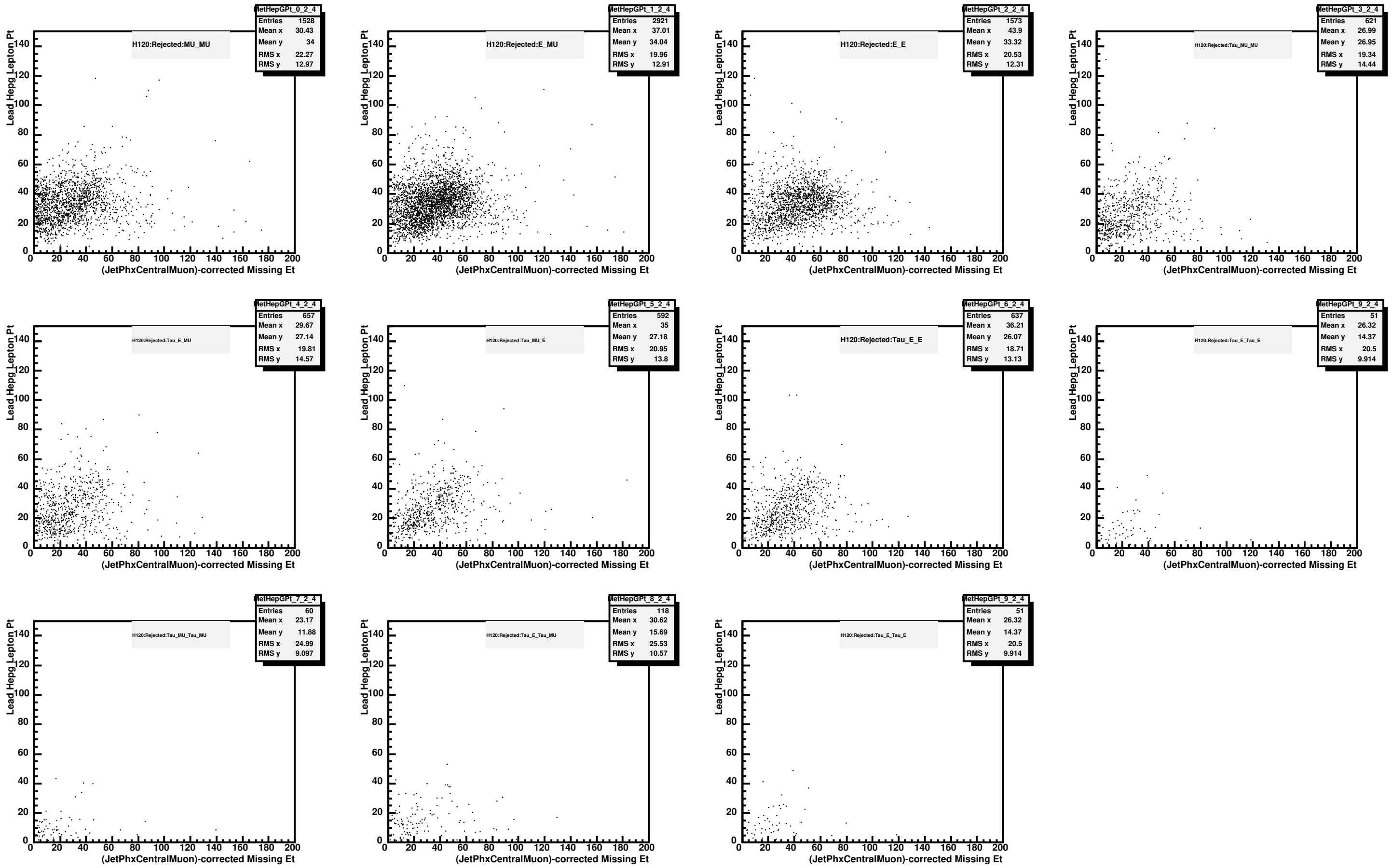
$$M_{Higgs} = 160$$



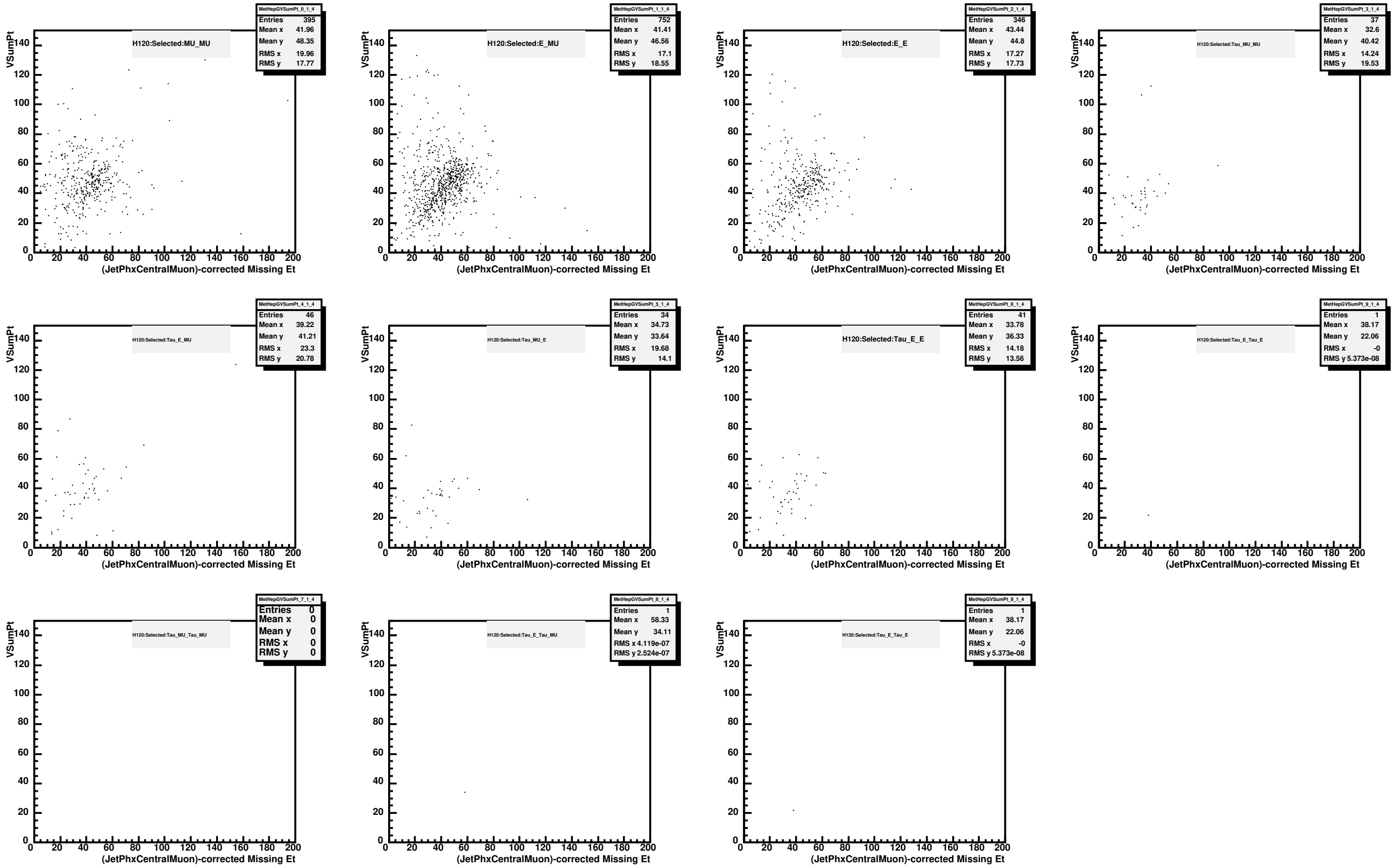
HEPG Lead Pt vs MET Selected$M_{Higgs} = 120$



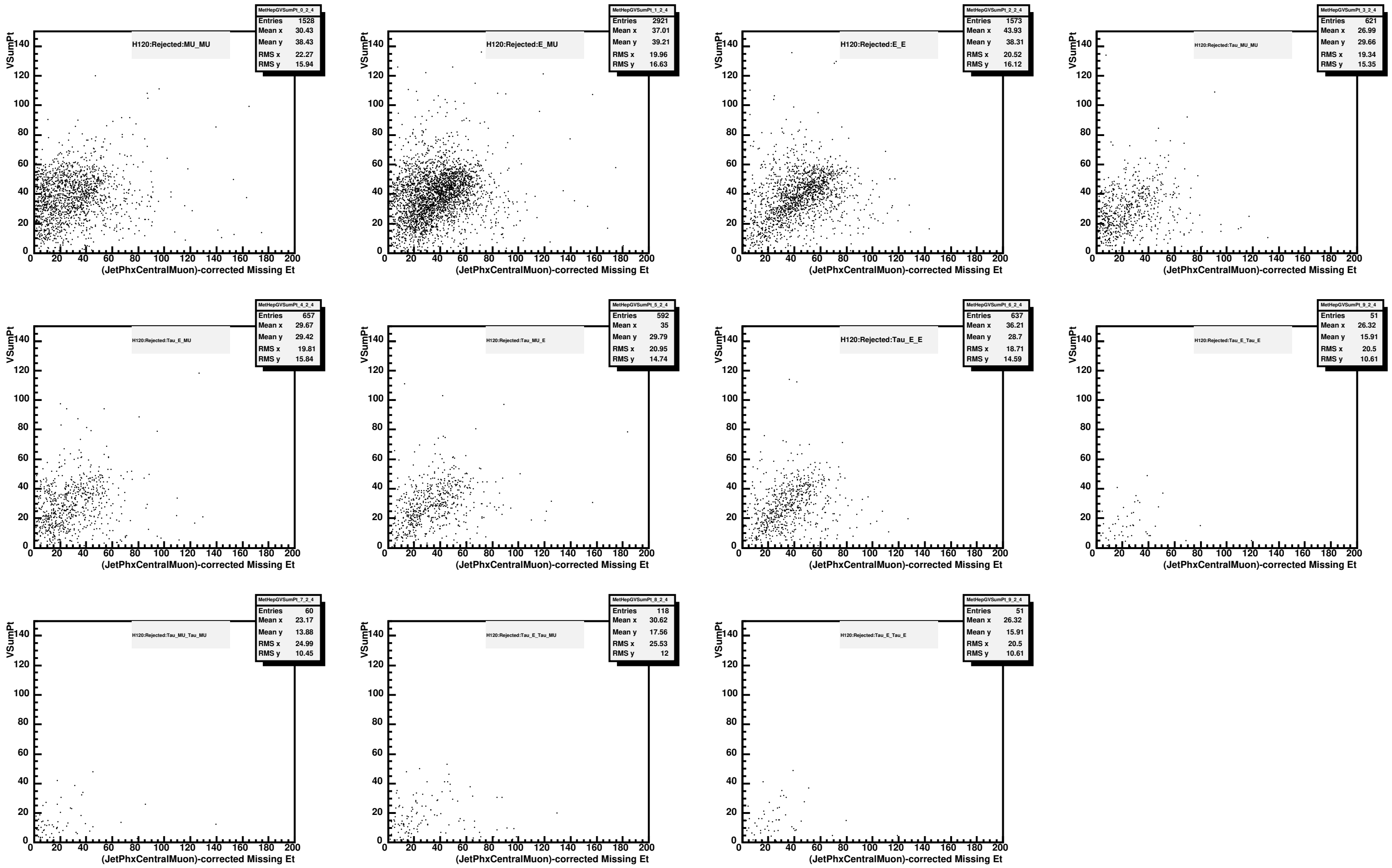
HepG Lead Pt vs MET Rejected $M_{Higgs} = 120$



HepG VSumPt vs MET Selected$M_{Higgs} = 120$



HepG VSumPt vs MET Rejected $M_{Higgs} = 120$



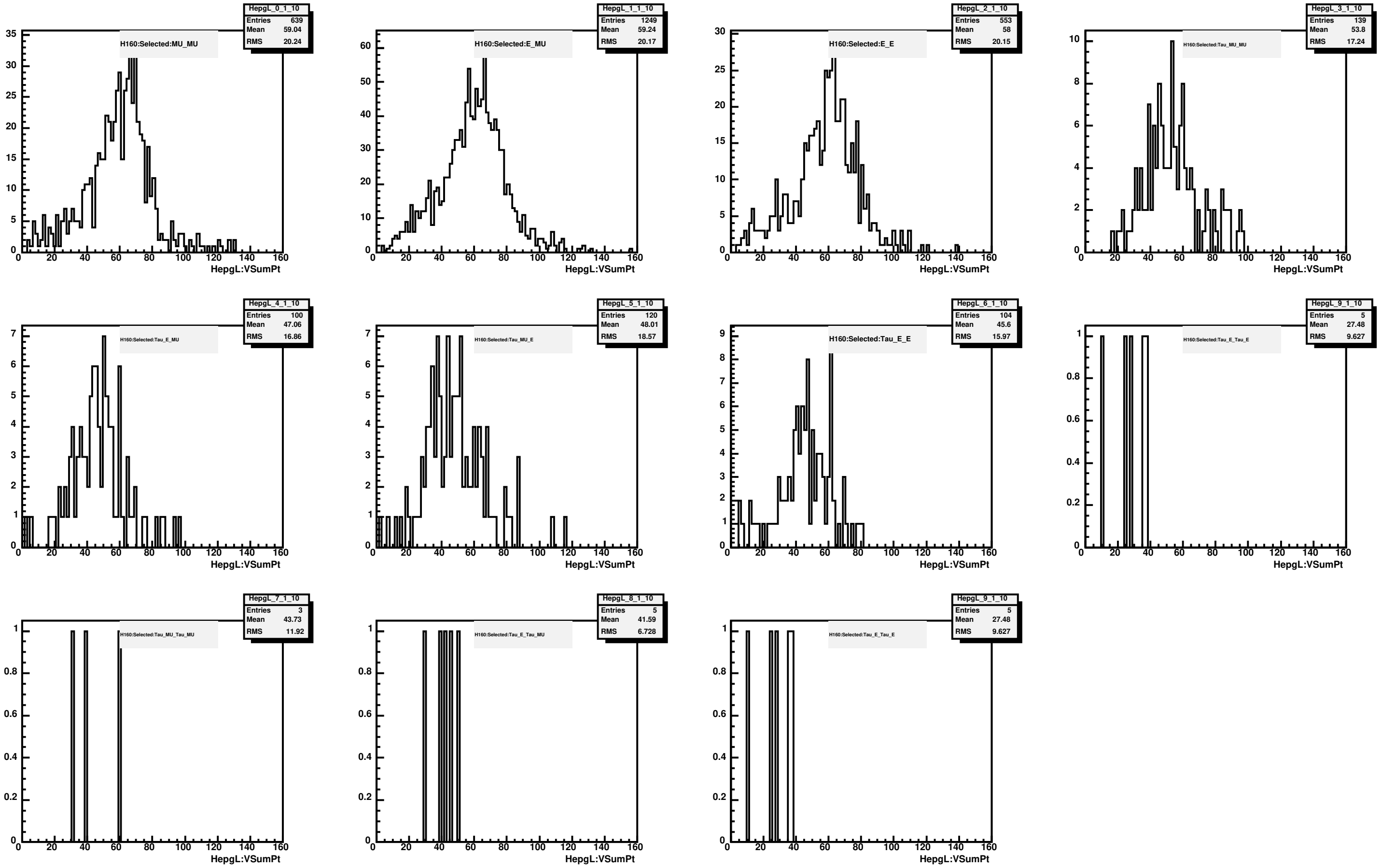
Conclusions

- VSumPt correlets strongly with MET.
- Lead Pt and “Charged stable lepton” Pt about same
- Sublead Pt and e or μ from τ Pt about same
- Need to look at how well reconstructed tracks match Hepg
- Need to compare VSumPt at recon and generator levels

Backups

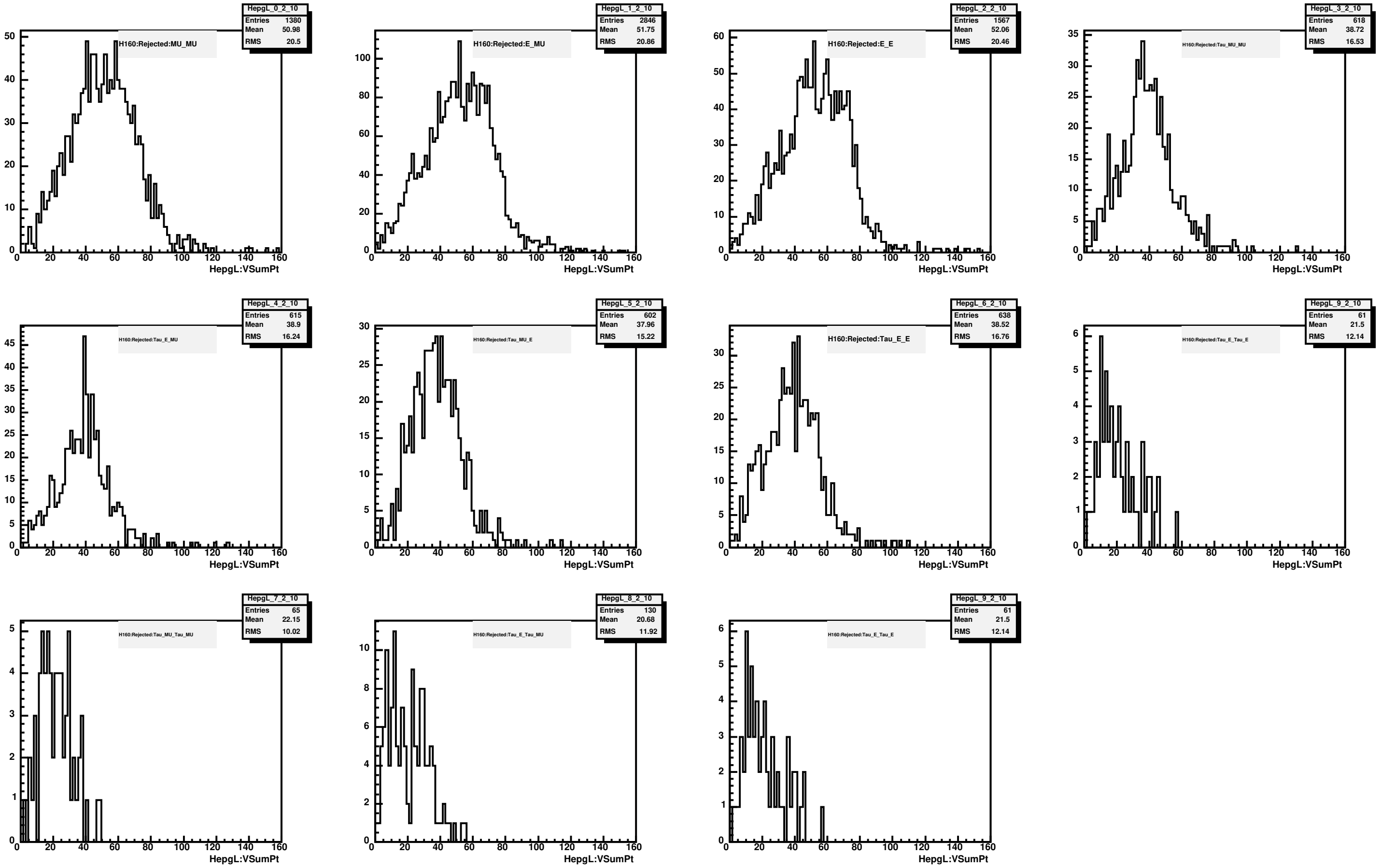
Kinematics: HepG: VSumPt Selected

$$M_{Higgs} = 160$$



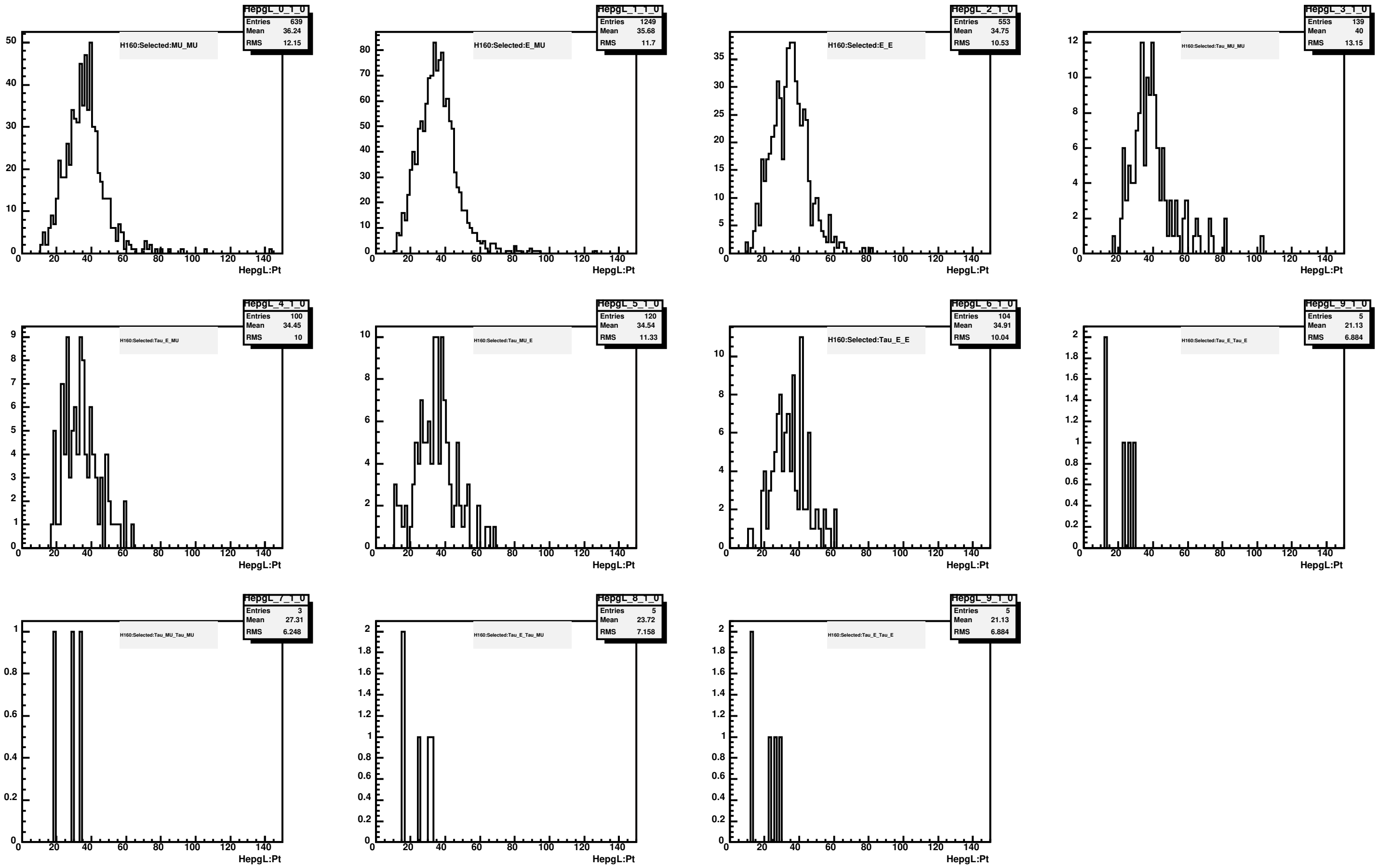
Kinematics: HepG: VSumPt Rejected

$$M_{Higgs} = 160$$



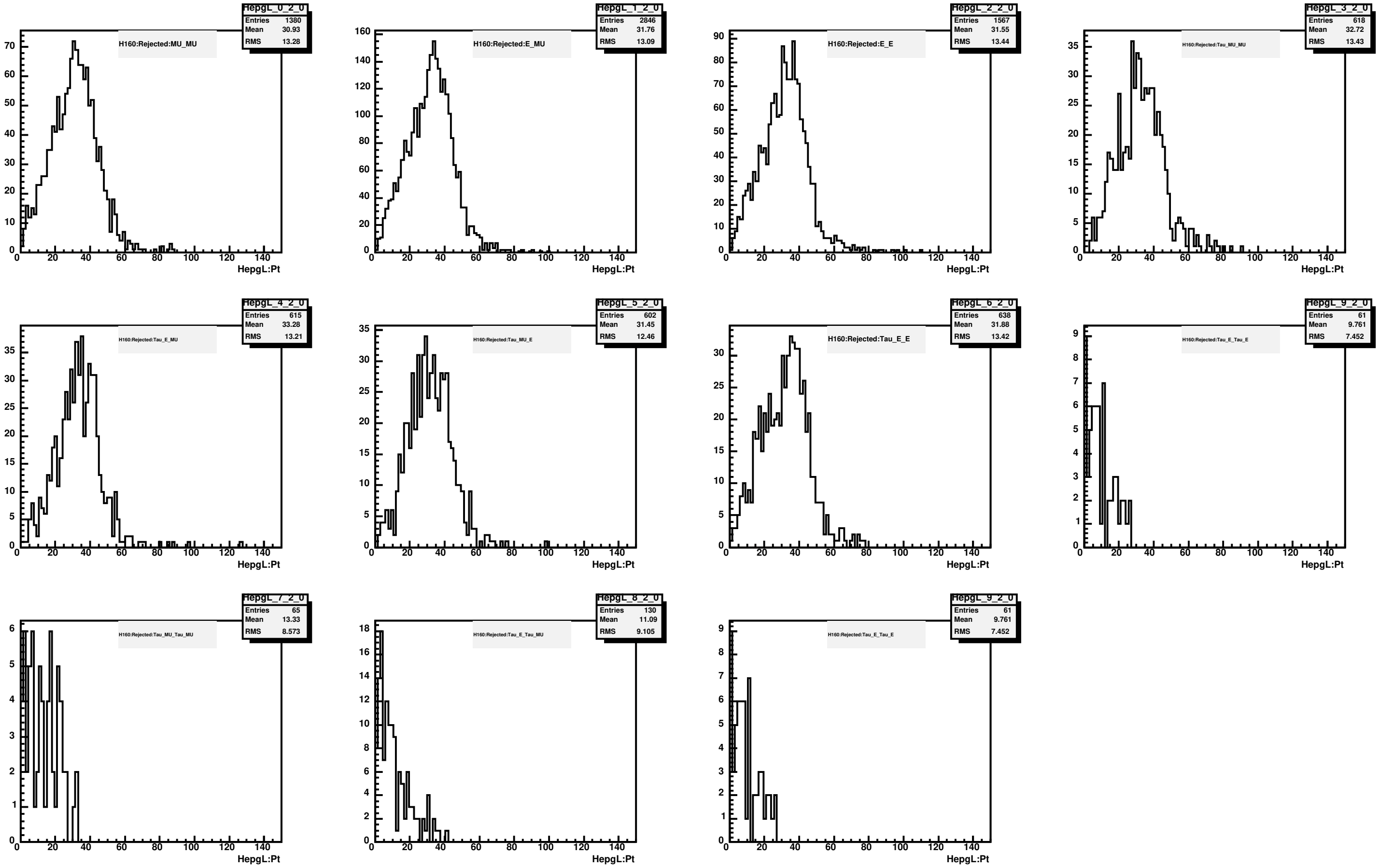
Kinematics: HepG: Pt1 Selected

$$M_{Higgs} = 160$$



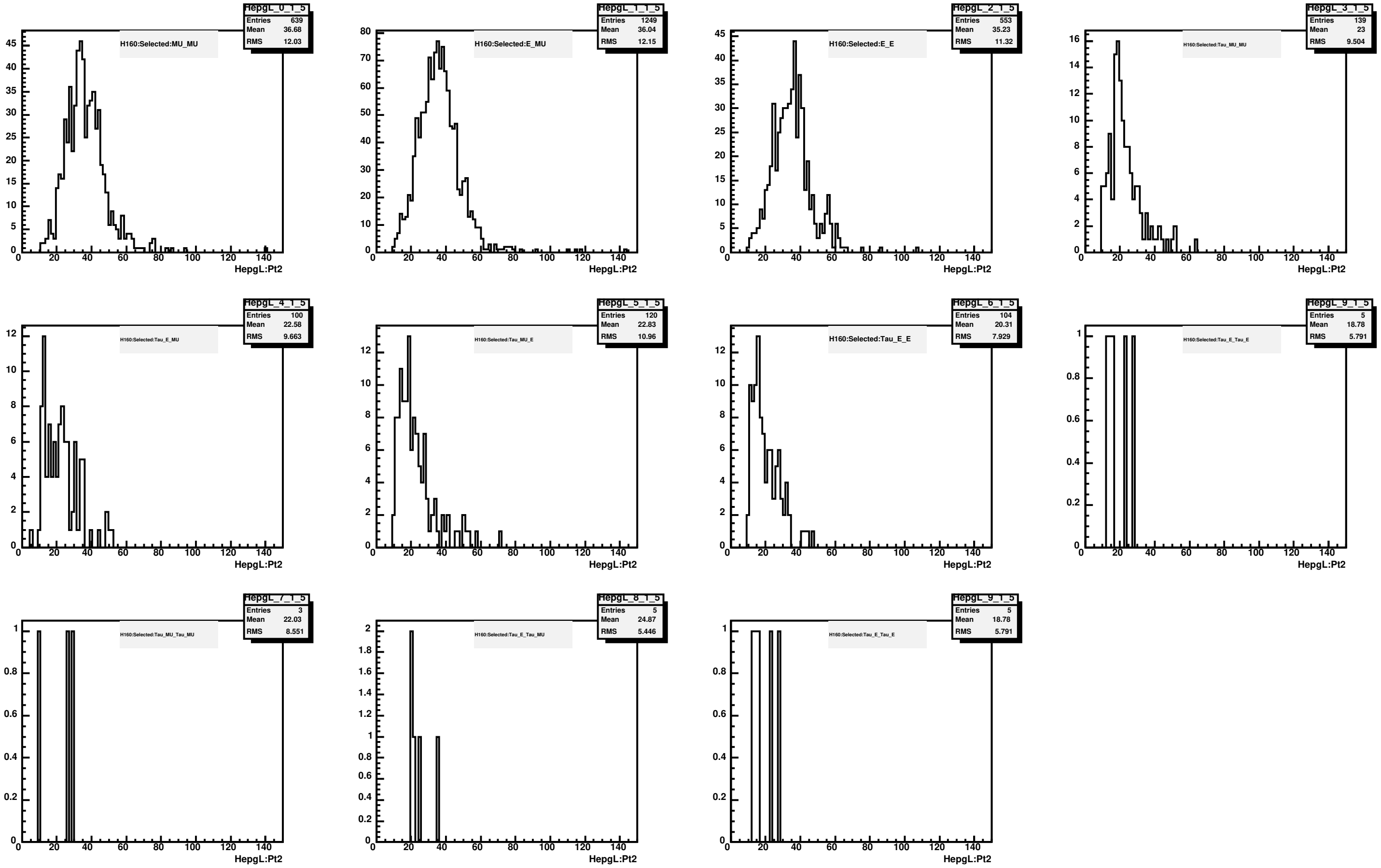
Kinematics: HepG: Pt1 Rejected

$$M_{Higgs} = 160$$



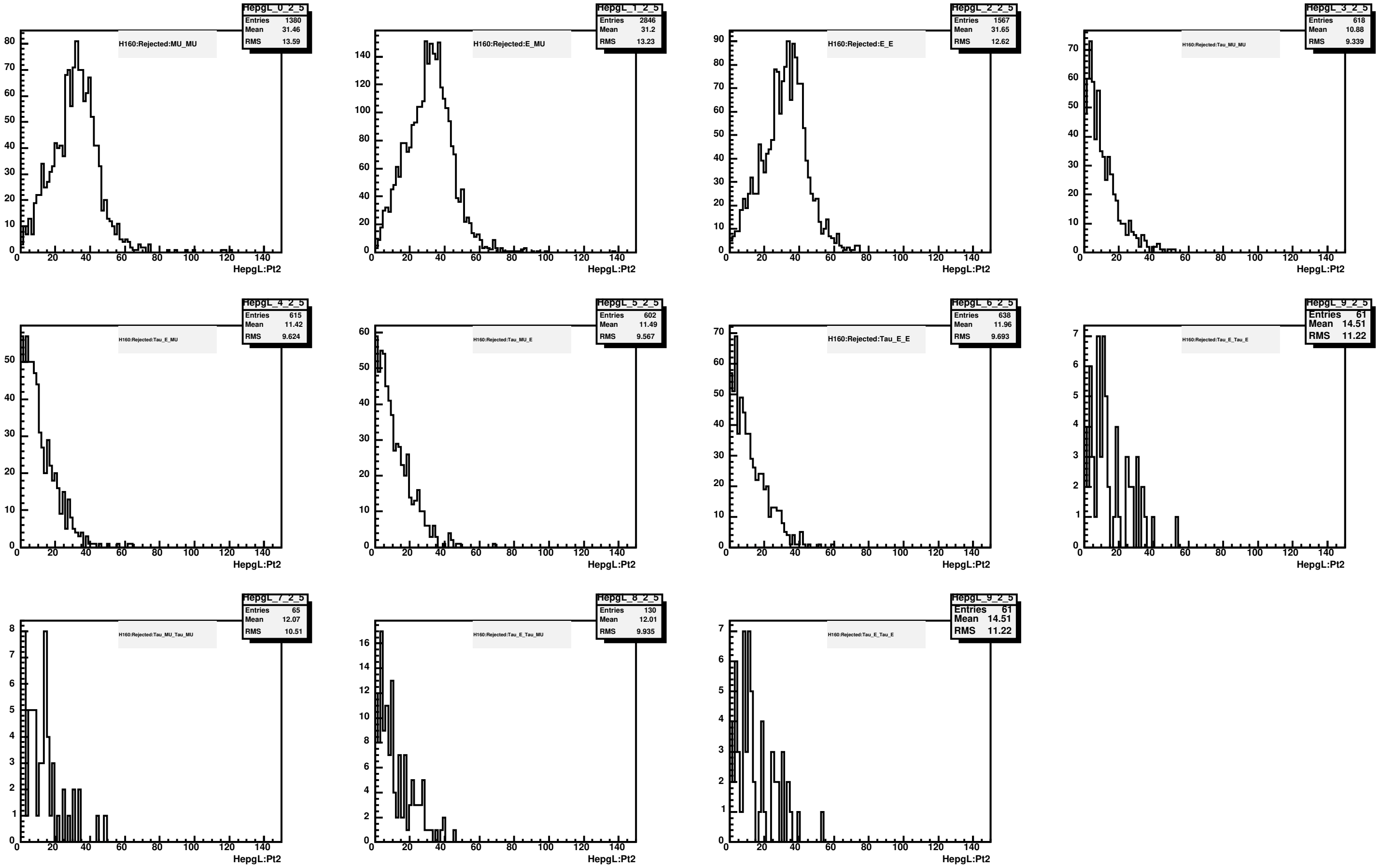
Kinematics: HepG: Pt2 (τ decay prod)

Selected $M_{Higgs} = 160$

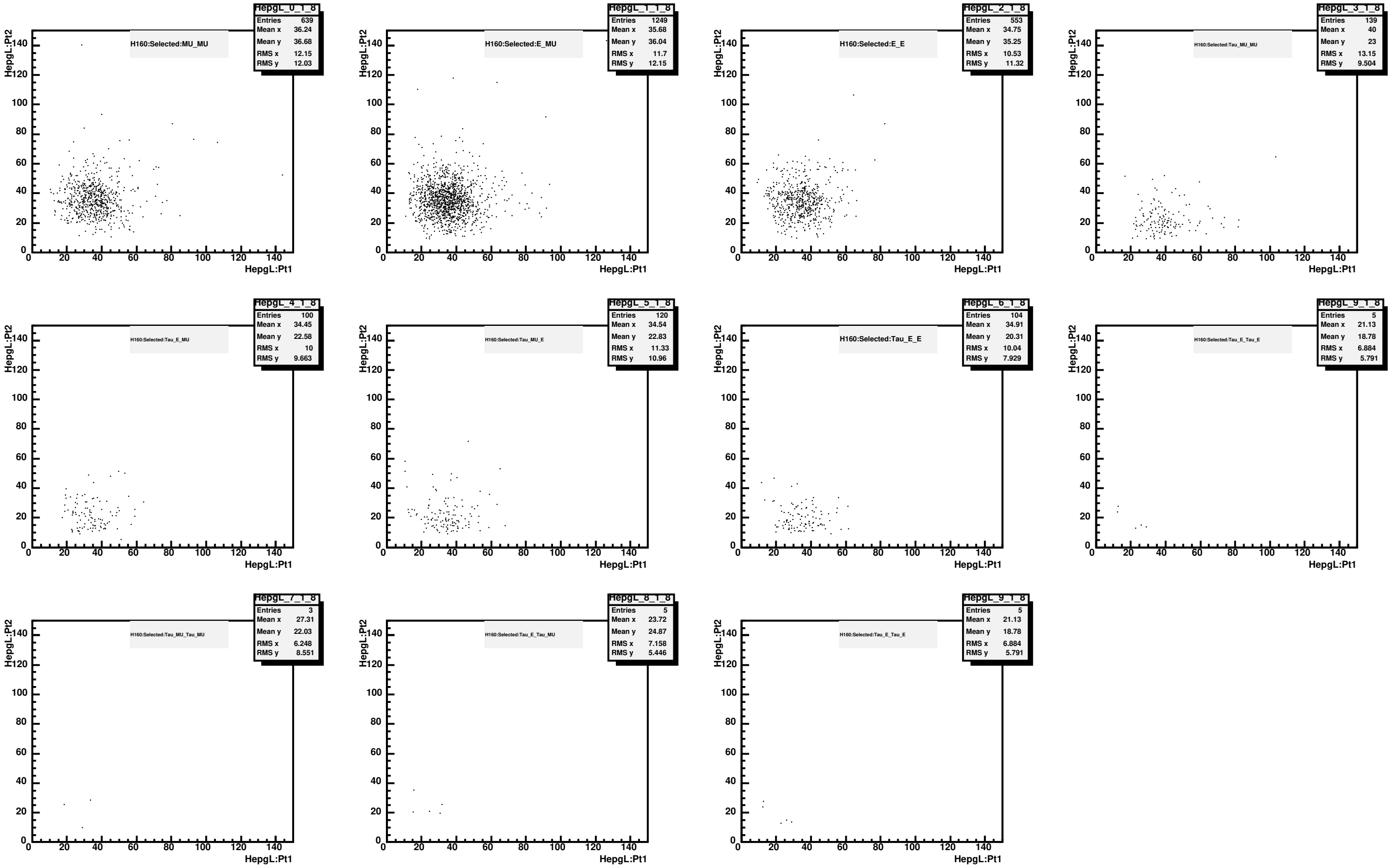


Kinematics: HepG: Pt2 (τ decay prod)

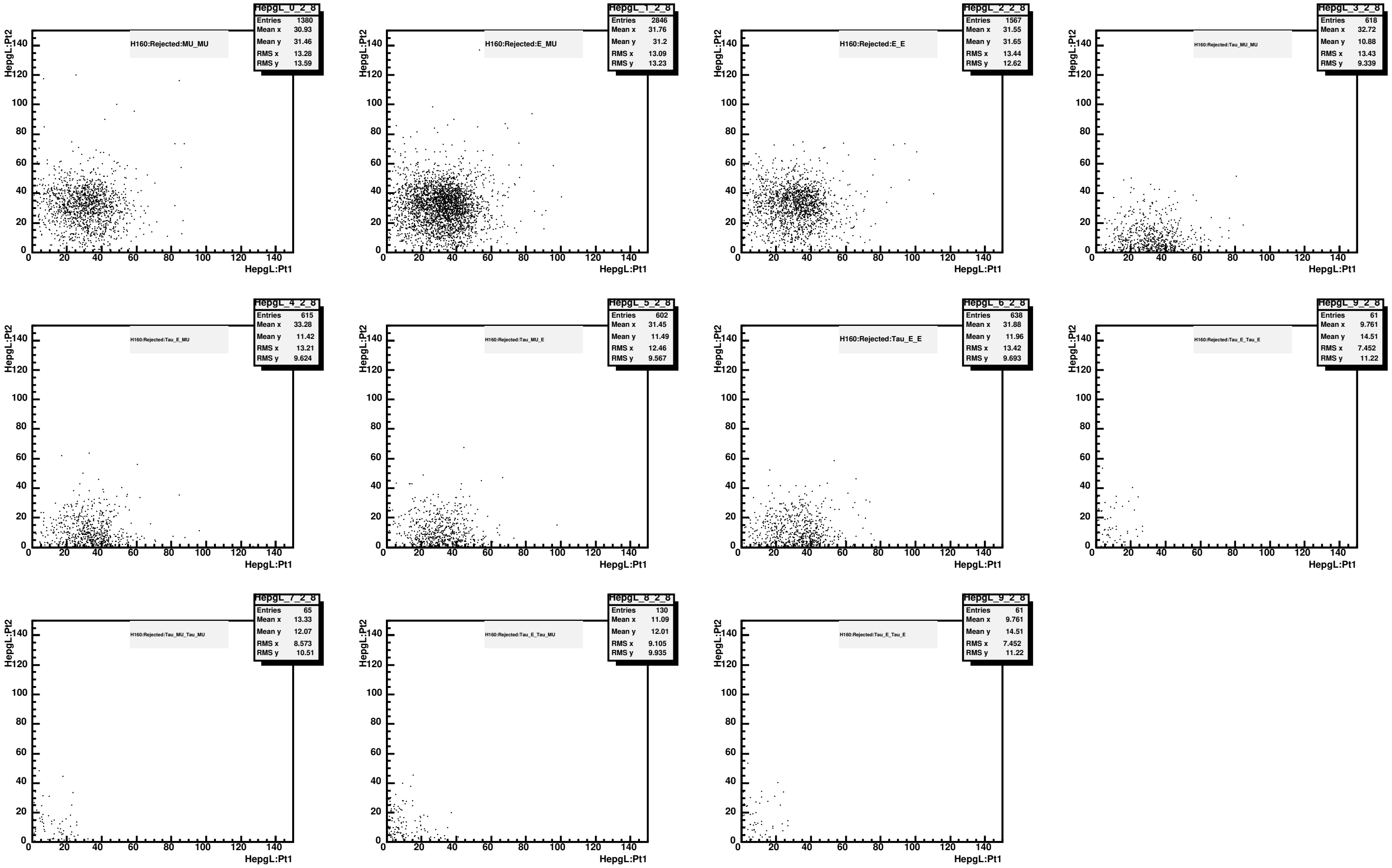
Rejected $M_{Higgs} = 160$



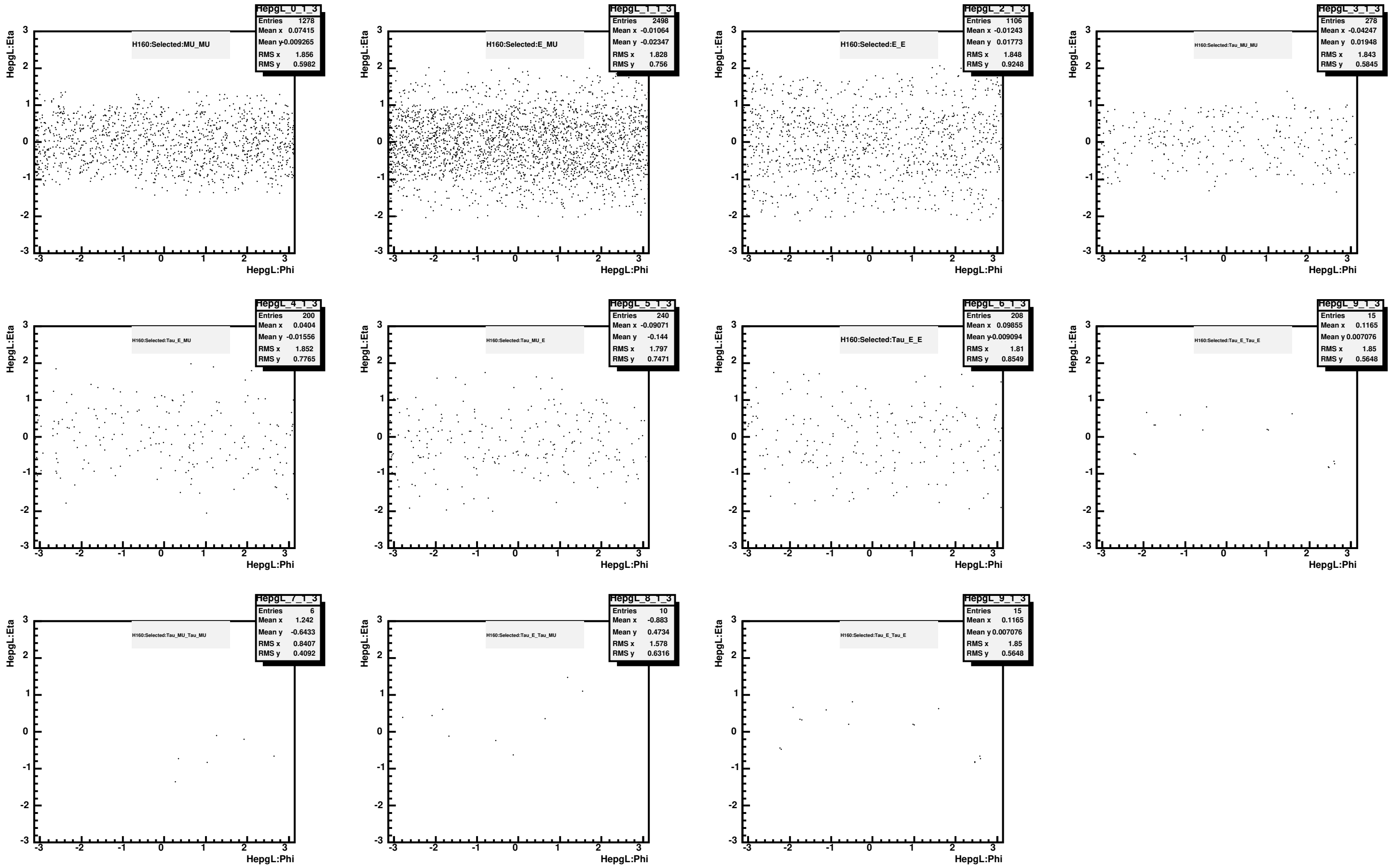
Kinematics: HepG: Pt1vs Pt2(τ decay prod) Selected $M_{Higgs} = 160$



Kinematics: HepG: Pt1vs Pt2(τ decay prod) Rejected $M_{Higgs} = 160$



Kinematics: HepG: Selected $M_{Higgs} = 160$



Kinematics: HepG: Rejected $M_{Higgs} = 160$